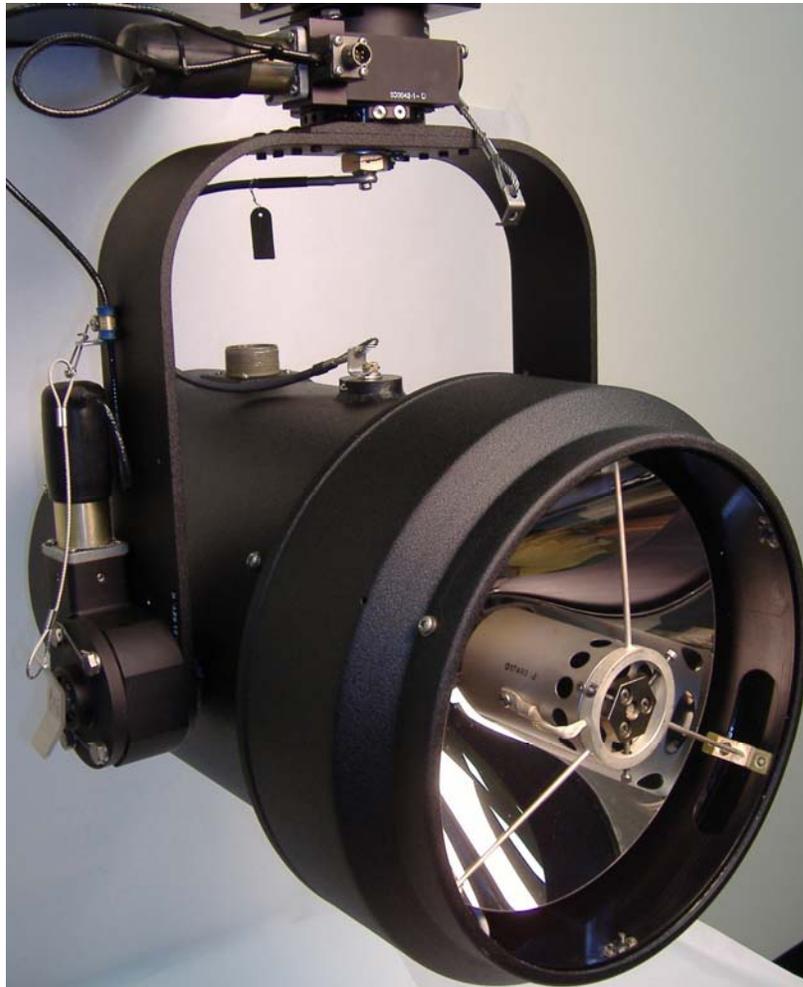


SX-16 Nightsun® Searchlight System Operation Manual



Spectrolab, Inc.
Illumination Products
www.Spectrolab.com

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1.0 INTRODUCTION TO THE SX-16 NIGHTSUN®

1.1 Description and Features

The SX-16 Nightsun® Searchlight System (called the SX-16 Nightsun® or simply the Searchlight from this point forward in the manual) is a versatile, mobile, high intensity light source. It can be mounted on fixed wing aircraft, helicopters, and water craft. When properly installed and operated, it can flood an area with light from a safe distance.

- The Searchlight uses an air cooled, high intensity xenon arc lamp. It emits light that is the same color as daylight, starts rapidly, and can be operated continuously or started and stopped to meet operational requirements.
- The Gimbal assembly that supports the Searchlight enables users to aim the Searchlight beam at various positions with respect to azimuth (horizontal directions) and elevation (vertical directions).
- The SX-16 Nightsun® responds to directional commands from a hand operated Control Box.

1.2 Applications

In addition to being approved by the Federal Aviation Administration (FAA) for installation on many helicopters operating in the United States, the SX-16 Nightsun® is particularly useful for nighttime reconnaissance when installed on fixed wing aircraft and water craft. Applications include law enforcement; search and rescue; assessment of emergency-landing and staging areas; surveillance of critical installations, borders, and coastlines; nighttime photography using color film designed for daytime use; and military operations. The SX-16 Nightsun® also is useful for applications that are not described in this manual. Please contact Spectrolab Customer Service to ask about your specific requirements.

1.3 About This Manual

This manual provides the following information:

- Information to help you to set up and connect the SX-16 Nightsun® components
- Information to help you operate the SX-16 Nightsun®

Separate manuals provide information about the following topics:

- Maintenance and troubleshooting
- Use of the In Flight Change Over (IFCO)

1.4 Read, Obey, and Keep Instructions

To ensure the safety of people and equipment, it is important to read and obey all instructions and safety warnings contained in this document and posted on the equipment before you attempt to operate, maintain, or troubleshoot the SX-16 Nightsun®. Keep this document for reference.



1.5 Installer Responsibility

It is the responsibility of SX-16 Nightsun® installers to ensure the integrity and safety of the installation, configuration, and integration with the aircraft or other operational platform.

1.6 Disclaimer

The information in this document is current as of the publication date. The manufacturer reserves the right to make changes to this document and products associated with it at any time without notice.

2.0 SAFETY

2.1 Product Safety

SX-16 Nightsun® poses the following hazards that can cause fatal or serious personal injury or damage to nearby property, including the aircraft:

- The Searchlight generates high voltages that can cause electrical shock.
- The Searchlight generates high temperatures that can cause a serious burn to a victim or start a fire.
- The Searchlight generates a high-intensity light that can cause blindness or start a fire.
- The Searchlight has a pressurized xenon gas arc lamp that poses an explosion hazard.

Obey the safety precautions in this section and the precautions displayed in each section at all times. Although the SX-16 Nightsun® is designed and manufactured to provide years of safe operation, you are responsible for using this product properly and safely. You also are responsible for training others to use and maintain this product safely. Do not take chances; contact Spectrolab if you have questions.

2.1.1 High Voltage Electrical Shock

The SX-16 Nightsun® generates voltages in the range of 125 to 150 volts DC and up to 25,000 volts AC. These voltages are present in both the Searchlight and Junction Box during the start cycle. To reduce the risk of death or serious injury from electrical shock:

- Never work alone when working on exposed electrical components.
- During close up inspection activities, remove the Control Box or its cable, or disconnect the Searchlight cable (power) so that the Searchlight cannot be turned on accidentally.
- High Searchlight voltages normally discharge a few seconds after the start cycle ends. Under certain malfunction or fault conditions, however, they may remain in the 25,000 VAC range.

- Use a voltmeter to verify that voltage in the Junction Box's 3400 μ f capacitor has discharged from its 125 to 150 VDC level before touching its terminals.
- Similarly, use a voltmeter to verify that the start signal to the Junction Box terminal strip is zero. This indicates that all power to the start circuit is off.

2.1.2 Lamp Explosion Hazard

The arc lamp contains xenon gas under pressure. Because the gas inside the lamp is pressurized, the lamp can explode without warning, especially when it is hot. If it explodes, it will shoot quartz particles in every direction. Always handle the Searchlight and lamp with caution, and ensure the safety of others.

- Never operate the Searchlight with the front window or rear cover removed.
- The Searchlight must be cooled to ambient temperature before you work on it
- If you must handle the arc lamp or work on the Searchlight head with the front lens removed, wear protective clothing that includes a face shield, a long sleeve heavy (leather) jacket, and gloves.
- Never leave an exposed xenon lamp unattended.

2.1.3 High-Temperature, High-Intensity Light

The light from the SX-16 Nightsun® is very powerful; the intense beam can cause serious eye injury or blindness, and the high temperatures pose a fire hazard. The Searchlight beam is hazardous to people and certain materials at close range, particularly at distances within 10 feet of the Searchlight. At a 10-foot distance, the beam intensity can be 100 times as powerful as direct sunlight, and its reflection can be more intense.

- Do not look into the Searchlight beam, and never shine the light at anyone within 125 feet of the Searchlight.
- At distances of less than 10 feet, flammable materials (such as human hair, clothing, wiping rags, paper, cardboard, wood boxes, electrical insulation, and most plastics) can and will be set on fire.
- During preflight tests on the ground, make sure that the beam is directed away from nearby people and flammable materials. Make sure to tell people not to look at or to walk through the Searchlight beam.
- For Searchlight adjustments that require visual observation of the light beam, always wear dark glasses that are equivalent to welders' glasses, shade 3.
- To avoid temporary blindness from reflected light, never operate the Searchlight in dense fog or while the aircraft is flying in clouds.

2.1.4 IFCO/IR Safety Precautions

If an infrared (IR) filter is used, the filtered beam of radiation emitted by the Searchlight is not easily detectable by the unaided human eye when the Searchlight is operating with the hood closed. For security patrols there should not be any white light leaks visible to the naked eye adapted to the darkness.

- Although you cannot readily see the filtered IR radiation emitted by the Searchlight, it has sufficient intensity (and wavelength) to cause severe and irreparable eye damage. Observe all warnings during operation and testing of the In Flight Change Over (IFCO) filter.

- All flight and ground personnel who may be exposed to a Searchlight operating with the filter in place at a distance of less than 500 feet should observe the following warning: ***do not look directly at a Searchlight that may be operating in the infrared range unless you are certain that it is not pointed toward you or is more than 500 feet away.***

2.1.5 Required Protective Equipment and Clothing

The gas pressure inside the xenon arc lamp makes the lamp a potential explosion hazard. Use the following safety equipment and wear the following protective clothing when exposed to a bare xenon arc lamp (for example, when working around the Searchlight head with the front lens removed from the Searchlight):

- Dark green safety glasses (Welding Safety Glasses, Shade 3.0), such as the Uvex Genesis (S3207), which are included in the basic PM expendables kit (PN 032376) and are available from Lab Safety Supply Co.
- Clear safety glasses and/or face shield, such as the Aerosite/Uvex Highflyer 9177, which are included in the basic PM expendables kit (PN 032376) and are available from American Optical or Uvex.
- Cut resistant safety gloves (Wells Lamont P/N 31417), which are included in the basic PM expendables kit (PN 032376), and which you can obtain from Lab Safety Supply Co.
- A long sleeve, heavy leather jacket
- A non-flammable target at which to aim the light beam during adjustments (do not use wood, cardboard, plastic, cloth, or paper as a target); there are two acceptable target types:
 - A piece of sheet metal that is 0.032” to 0.125” (0.7 mm to 3 mm) thick and approximately 3 feet (1 m) across painted with a high temperature resistant black (or dark brown) paint on one side and white (or light colored) high temperature resistant paint on the other side. The high temperature resistant paint should be resistant to 500° F (260° C). Barbecue or automotive exhaust manifold paint works well. The target should be well supported by a stand that is non-flammable. During use, it will become very hot and should not be handled until it has cooled. A fan can be used to cool the target.
 - A woven aluminum air handling filter (the washable type used to catch cooking grease in over the grill venting systems.) If the filter is painted black, it can be an effective fireproof lamp target. Its large surface area helps to keep it cool. You can use a fan to help cool the target.

2.1.6 Trained Operators and Maintenance Personnel

Only trained staff should operate the Searchlight. Furthermore, all installation, maintenance, troubleshooting, and repairs should be performed only by experienced technicians who have skill and knowledge about aircraft airframes and electrical systems.

- Because the SX-16 Nightsun® is subject to vibration in its normal operating environment, the hardware used for system attachment requires positive locking features such as locknuts and lock wire.
- The SX-16 Nightsun® contains parts that users can maintain and replace; however, there are no factory-approved processes for rebuilding any worn parts; they must be replaced. If you have questions about what is and what is not repairable, please contact Spectrolab Customer Service at 800-936-4888.

Source: Spectrolab, Inc.

2.1.7 Handling Precautions

Do not lift the SX-16 Nightsun® using locations that are not designed to bear the weight or strain of being lifted.

- During inspection, cleaning, and maintenance, do not grasp the Gimbal motors or the connector interfaces on the Gimbal or Searchlight to lift it. Instead, use the handle on the back of the Searchlight, or lift the Gimbal yoke itself.
- When maintaining exposed electrical components, never work alone.
- As the Gimbal rotates, the Gimbal motors develop forces that can injure personnel. Keep a safe distance from the Gimbal to avoid possible injury.
 - Do not place fingers inside the Gimbal's area of motion when the power is on. The moving parts can trap loose clothing and cause personal injury.
 - To avoid injuries, keep people and loose fitting clothing away from the equipment during operation

2.1.8 Installation Location Safety

Before installing the Searchlight, test the installation location:

- During operation, the Searchlight's high intensity light beam can cause heat damage to exposed surfaces, especially if the light is aimed at a surface for long periods of time.
 - Provide for heat dissipation from the Searchlight head during operation.
 - Do not install the Searchlight in locations that allow the light beam to be aimed at nearby temperature sensitive surfaces without taking appropriate steps to mitigate possible damage. The light absorbed by dark colored surfaces can cause them to reach combustion temperatures under some conditions.
 - If the Searchlight is installed on an aircraft that is equipped with floats, the mechanical stops for azimuth and elevation may have to be adjusted. Adjust the stops to limit the movement of the Searchlight to prevent it from shining directly at the floats. The Searchlight beam can melt a hole in floats at close range.
- Do not expose fuel or other volatile substances to the Searchlight beam.
- Prevent the Searchlight from being aimed in ways that adversely affect the aircraft crew.
- Install a circuit breaker (for the SX-16 Nightsun®) that is accessible to the aircraft crew.
- Make sure that the Searchlight does not interfere with aircraft instrumentation or radios.
- Make sure that the Searchlight does not overload the aircraft's electrical system when all other anticipated electrical systems are operating.

2.2 Safety Messages Used in this Manual

This manual contains important safety messages that are identifiable by their appearance. These safety messages identify hazards and contain information to help you avoid personal injury, death, and property damage to the Searchlight, aircraft, or other property. All of these safety messages contain an exclamation symbol (!) surrounded by a triangle. There are three types of safety message used in this manual.

- *Danger* notices indicate a hazardous situation that will result in death or serious injury if not avoided (Figure 1). A danger message has the following appearance:



Figure 1 Danger Message (Example)

- *Warning* notices indicate a hazardous situation that could result in death or serious injury if not avoided (Figure 2). A warning message has the following appearance:



Figure 2 Warning Message (Example)

- *Caution* notices indicate a hazardous situation that could result in minor or moderate injury if not avoided (Figure 3). A caution message has the following appearance:



Figure 3 Caution Message (Example)

2.3 Notice Messages

- *Notice* messages are also used in this manual (Figure 4). These notices contain special instructions that are important, but they are not related to safety issues. Notice messages have the following appearance:



Figure 4 Notice Message (Example)

3.0 SX-16 NIGHTSUN® SYSTEM OVERVIEW

3.1 Components

Figure 5 depicts the basic components of the SX-16 Nightsun® System.

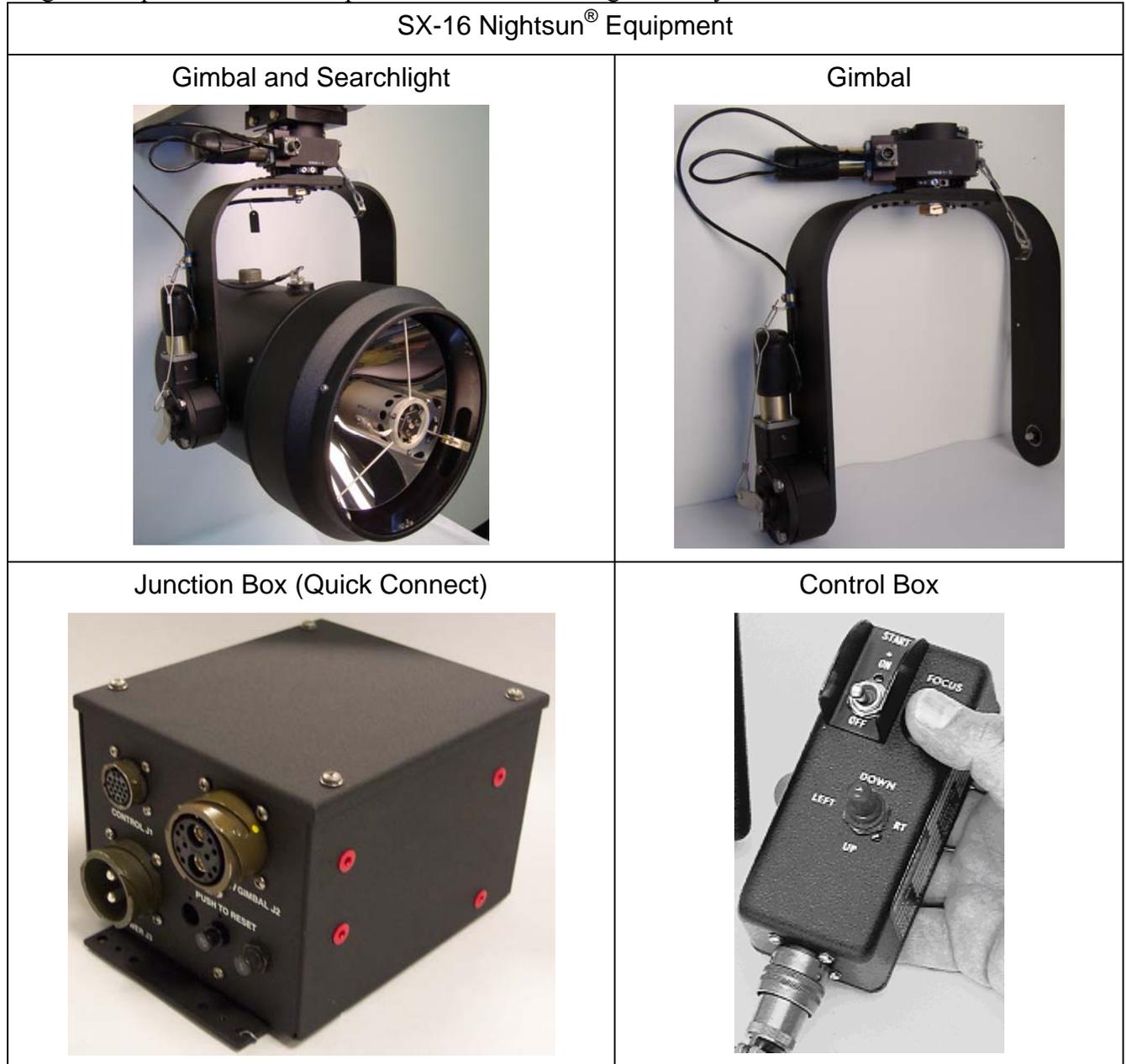


Figure 5 Basic Components

Figure 6 depicts the enhanced components of the SX-16 Nightsun® System.

Enhanced SX-16 Nightsun® Equipment	
<p>Back Cover Assembly</p>  A circular black back cover assembly with a central handle and several screws around the perimeter.	<p>Control Box</p>  A vertical black control box with various controls: a 'START ON' knob, a 'LAMP OFF' knob, a 'DOWN' knob with 'LT' and 'RT' markings, an 'UP' knob, a 'FOCUS' knob, and a 'LINK/CAL' knob.
<p>Junction Box with Fan</p>  A black rectangular junction box with a fan on top and various connectors on the front panel.	

Figure 6 Enhanced Components

3.2 Connections

The SX-16 Nightsun® system includes a Control Box, Junction Box, Gimbal, Searchlight, and cables. Figure 7 depicts the connections between the main components of the SX-16 Nightsun®. It identifies the components, the connectors on each component (J1 on the Junction Box for example), and the cables attached to each connector. The Junction Box links most of the SX-16 Nightsun® components. This section of the manual addresses the following connections:

- Junction Box to the Control Box
- Junction Box to the Gimbal Assembly and Searchlight
- Junction Box to the input power

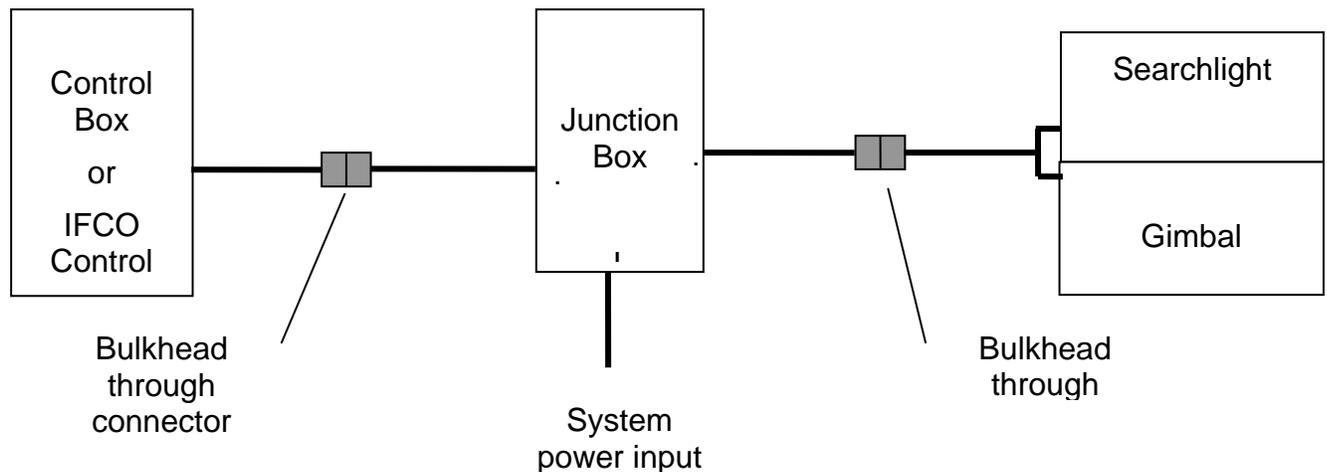


Figure 7 Overview of Connections between SX-16 Nightsun® Components

3.2.1 Junction Box to Control Box

In the compartment where the Control Box will be used to operate the Searchlight, connect one end of the control cable to the connector on the base of the Control Box. Connect the other end of the cable to the bulkhead through connector.

On the other side of the bulkhead, connect one end of the straight control cable to the bulkhead through connector. Connect the other end of the cable to the J1 connector on the Junction Box.

3.2.2 Junction Box to Gimbal Assembly and Searchlight

In the compartment where the Junction Box is installed, connect one end of the Junction Box to bulkhead cable to the J2 connector on the Junction Box. The other end of the cable is the bulkhead through connector leading to the exterior of the vehicle, where the Gimbal assembly is installed.

On the exterior of the aircraft:

- Connect one end of the bulkhead to Gimbal cable to the bulkhead through connector. On the other end, connect the portion of the cable to the 4-pin connector on the Gimbal.
- Connect the Searchlight portion of the cable to the 12-pin power connector on the Searchlight.

3.2.3 Junction Box to Input Power

Make sure that the Control Box On switch is set to the Off position.

Connect one end of the power cable to the J3 connector on the Junction Box. Connect the other end of the power cable to the power source.

3.3 Cabling

The SX-16 Nightsun® relies on various cables for power and communication. These cables use bulkhead through connectors to support installation on a variety of vehicles.

- Control Box connector to Bulkhead Control connector
- Bulkhead Control connector to Junction Box connector
- Junction Box connector to Bulkhead system power input connector
- Junction Box Gimbal/Searchlight connector to Bulkhead connector
- Bulkhead connector to Gimbal and Searchlight connectors

4.0 GIMBAL ASSEMBLY

4.1 Functional Description

The Gimbal assembly (Figure 8) has a U-shaped yoke (the Gimbal arm) made of ¼" x 3" high-strength aluminum or steel alloy. When fully assembled, it serves the following functions:

1. it mechanically supports the Searchlight and the attachment to the aircraft;
2. it provides the electrical and communication link between the Searchlight and Junction Box;
3. it contains gears, electronic equipment, and separate DC motors that adjust the Searchlight's azimuth and elevation positions. Consequently, the Gimbal assembly enables the Searchlight to be pointed in various directions.

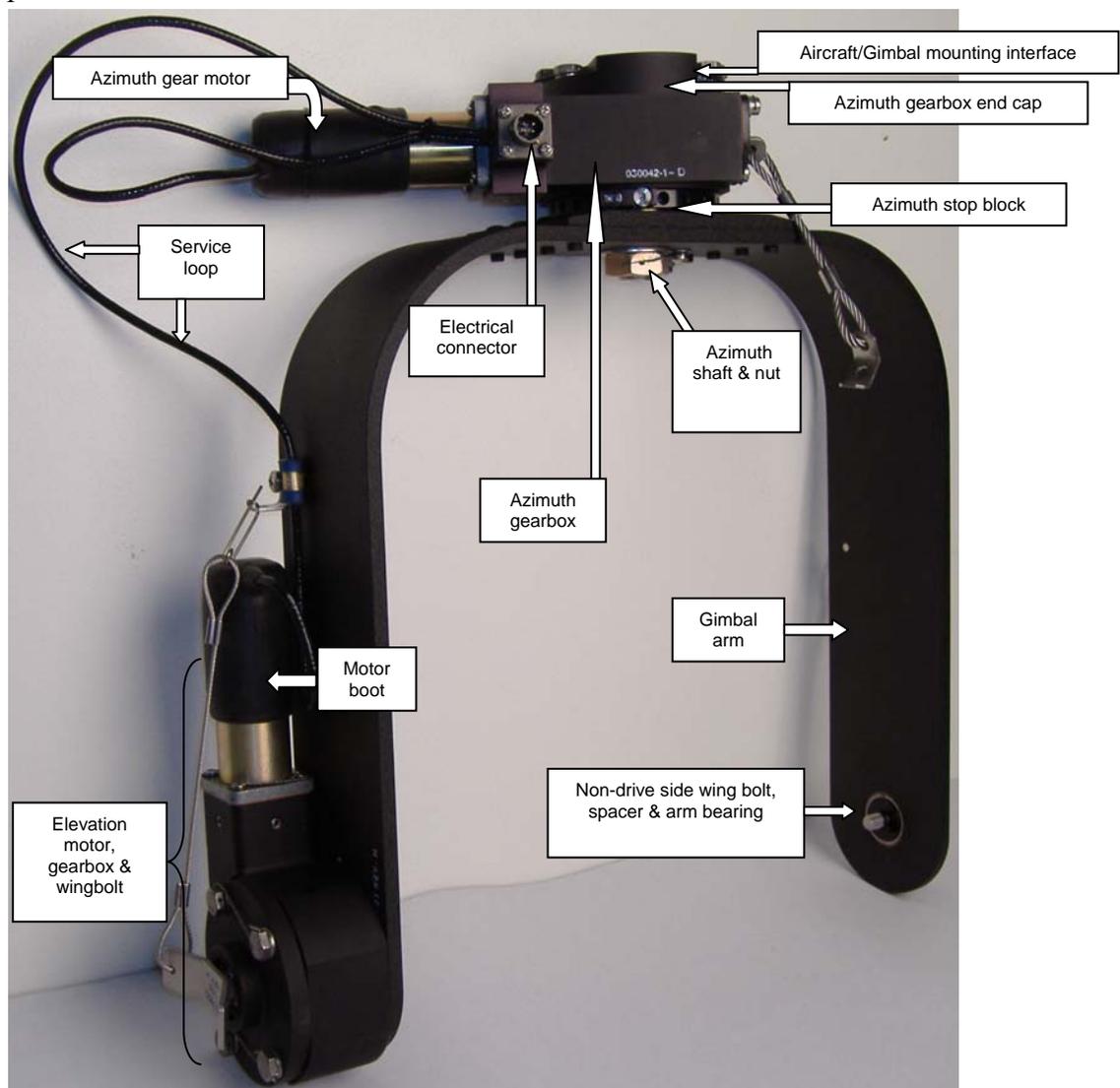


Figure 8 Gimbal Assembly (Current Configuration)

Mounting Bracket

Source: Spectrolab, Inc.

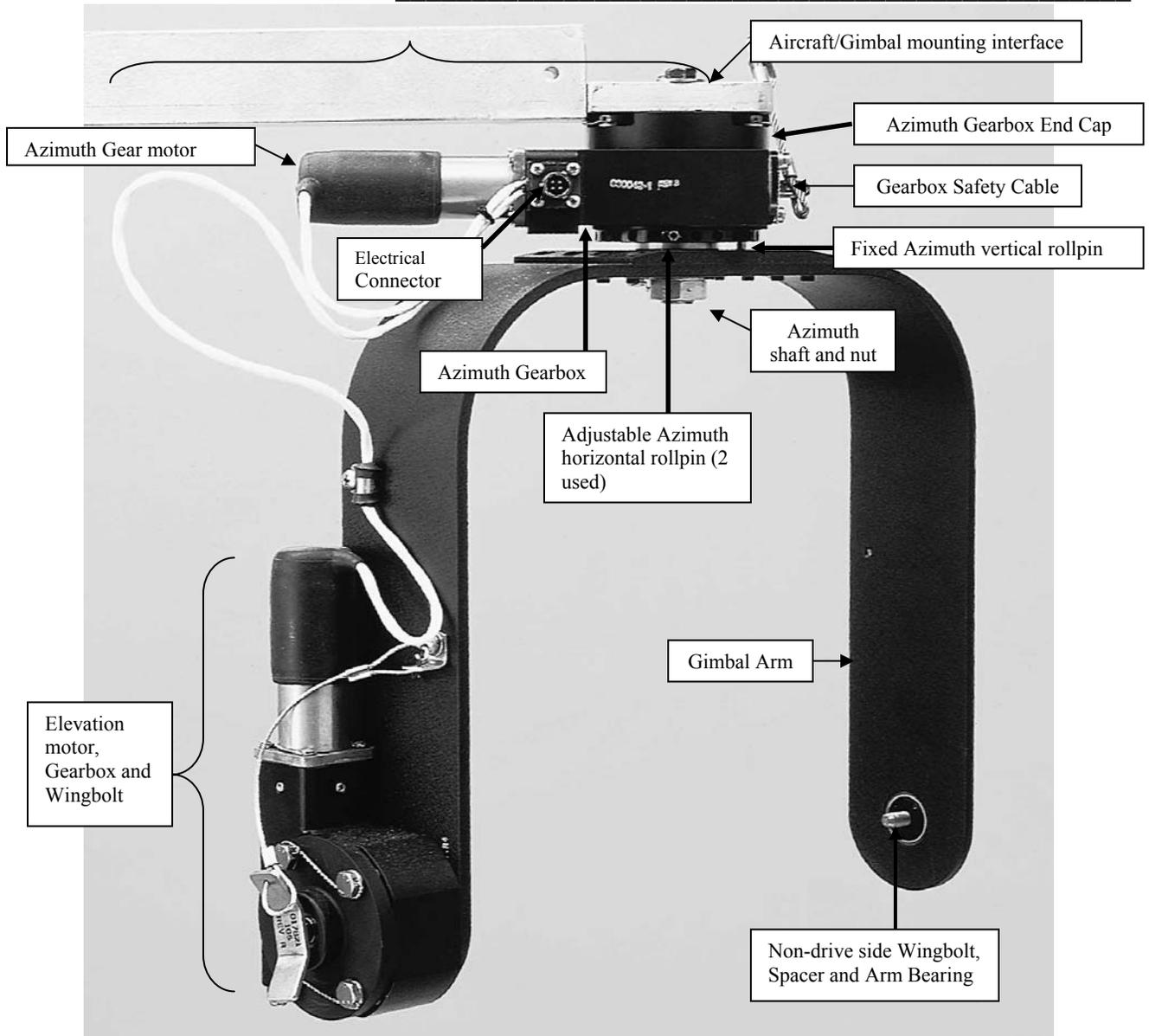


Figure 9 Gimbal Assembly (Old Configuration)

4.2 Detailed Description

4.2.1 Configurations Available

The Gimbal assembly is available in two configurations that have differences in their mechanical azimuth stops:

- The current configuration, which was introduced in August 2004 (Figure 8), has two adjustable stop blocks attached to the azimuth ring by two shoulder bolts. It also has a high strength, stationary shoulder bolt mounted on the doubler (the top of the yoke, where its thickness has been doubled). In Figure 8, the following items are visible (from top to bottom): aircraft/Gimbal mounting interface; azimuth gearbox end cap (bolted to mounting bracket); azimuth gear motor; azimuth stop block; gearbox safety cable; service loop; electrical connector; azimuth shaft and nut; azimuth gearbox; motor boot; elevation motor, gearbox, and wing bolt; non-drive side wing bolt, spacer, and arm bearing.
- The old configuration (Figure 9) has fixed azimuth horizontal roll pins that are pressed into radiating holes on the outer edge of the gearbox adapter. It also has a vertical roll pin mounted on top of the doubler. In Figure 9, the following items are visible (from top to bottom): mounting bracket; azimuth gear motor; aircraft/Gimbal mounting interface; azimuth gearbox end cap (bolted to mounting bracket); gearbox safety cable; service loop; electrical connector; azimuth gearbox; azimuth shaft and nut; fixed azimuth horizontal roll pin (two used); motor boot; elevation motor, gearbox, and wing bolt; non-drive side wing bolt, spacer, and arm bearing.
- Spectrolab Gimbal assemblies also include configurations that accommodate:
 - Various mounting locations
 - Various speed and weight restrictions: (1) a light weight aluminum version for slow speed aircraft and (2) a heavier, high strength steel version for high speed aircraft
 - Variations in light: (1) a basic, white light version and (2) a remote controlled, In Flight Change Over (IFCO) version that accommodates a filter
 - Some users modify the Searchlights by adding limit switch type sensors or optical switches that are tied into an auto-stow circuit. In general, these circuits enable the Searchlight to rest in a home position that is horizontal (and points forward) when it is turned off. This increases the Searchlight to ground clearance on some belly mounted installations. Spectrolab's add on system, called SpectroLink, provides this auto-stow feature, and it can be attached to the Gimbal assembly and Junction Box. SpectroLink also enables accessory equipment (such as a movable camera) to control the movements of the Searchlight. As a result, the movements of the accessory equipment can be synchronized with the movements of the Searchlight. There is a separate manual for the installation and operation of SpectroLink.
- The latest configuration is the enhanced SX-16 system. This configuration adds backwards compatible enhanced components such as; Gimbal, Searchlight, Junction Box and Control Box.
 - The enhanced Gimbal adds features such as; a non-restricted service life limit, precision fit gearboxes that minimize the amount of backlash to less than 1°, and integrated adjustable elevation stop blocks.

Source: Spectrolab, Inc.

- The enhanced Searchlight add features such as: a Lamp hour meter, bi-directional focus, collector that yields an increase of 20 percent light output, brushless cooling blower with a service life of 10,000 operating hours that improves airflow.
- The enhanced Control Box adds features such as; a separate lamp off switch that allows the fan to properly cool the lamp and alleviates the operator to remember the proper cooling procedure, bi-directional focus switch.
- The enhanced Junction Box adds the cooling fan on the lid forces cool air to prevent overheating the temperature sensitive circuit breakers.

4.2.2 Elevation Attachment and Movement

The elevation gearbox and motor are mounted on one side of the Gimbal arm, which is called the drive side. On the drive side of the Gimbal arm:

- The wing bolt passes through the elevation gearbox into the Searchlight's other mounting boss.
- A square drive output shaft on the elevation gearbox slips into a mating socket in the Searchlight's elevation stop, and this transmits the output power from the gearbox directly to the Searchlight.
- Screw heads (or drive pins) project from the inside of the Gimbal arm and come into contact with the Searchlight's elevation stop.
- The elevation stop limits Searchlight movement and prevents it from pointing in detrimental directions. The elevation stop is fixed (cannot be adjusted).
- The service loop between the elevation gearbox motor and Gimbal connector permits motion between the Gimbal arm and the azimuth gearbox, which remains stationary.
- On the non-drive side of the Gimbal arm (the right hand side of Figure 8 or Figure 9) you can see the threaded portion of the wing bolt projecting outward from the spacer and arm bearing. This portion of the wing bolt screws into one of the Searchlight's mounting bosses and extends through the arm bearing.

4.2.3 Azimuth Attachment and Movement

The azimuth gearbox and motor are mounted at the top of the Gimbal arm (where it attaches to the aircraft).

- The azimuth gearbox has a shaft that secures the Searchlight to the aircraft mounting bracket through four mounting bolts. This shaft supports the entire weight and aerodynamic load of the Searchlight and Gimbal assembly.
- A combination of fixed (cannot be adjusted) and adjustable azimuth stops limit Searchlight motion to prevent it from pointing in detrimental directions. These fixed and adjustable stops are located around the bottom of the azimuth gearbox and on the top of the Gimbal arm doubler (the top of the yoke, where its thickness has been doubled).

4.3 Enhanced Gimbal

The enhanced Gimbal (Figure 10) is constructed with high strength Aluminum Alloy and to provide an unrestricted service life limit. The enhanced Gimbal integrates reinforcement features such as a one piece arm, ribbed bends and a flared design to provide structural integrity. Precision gearboxes augment performance by allowing backlash of less than 1 degree, adding a sealed enclosure, dry lube treated gears, and a precise fit end cap. The enhanced Gimbal high-speed motors offer a slew rate of up to 18° degrees per second. Elevation stop blocks are incorporated to improve ease of adjustments of upper and lower elevation limits in 2° increments. Elevation stop block shown is for illustration purposes and may vary from current design. The enhanced Gimbal is intended to be backwards compatible to all SX-16 Nightsun® Searchlight systems.

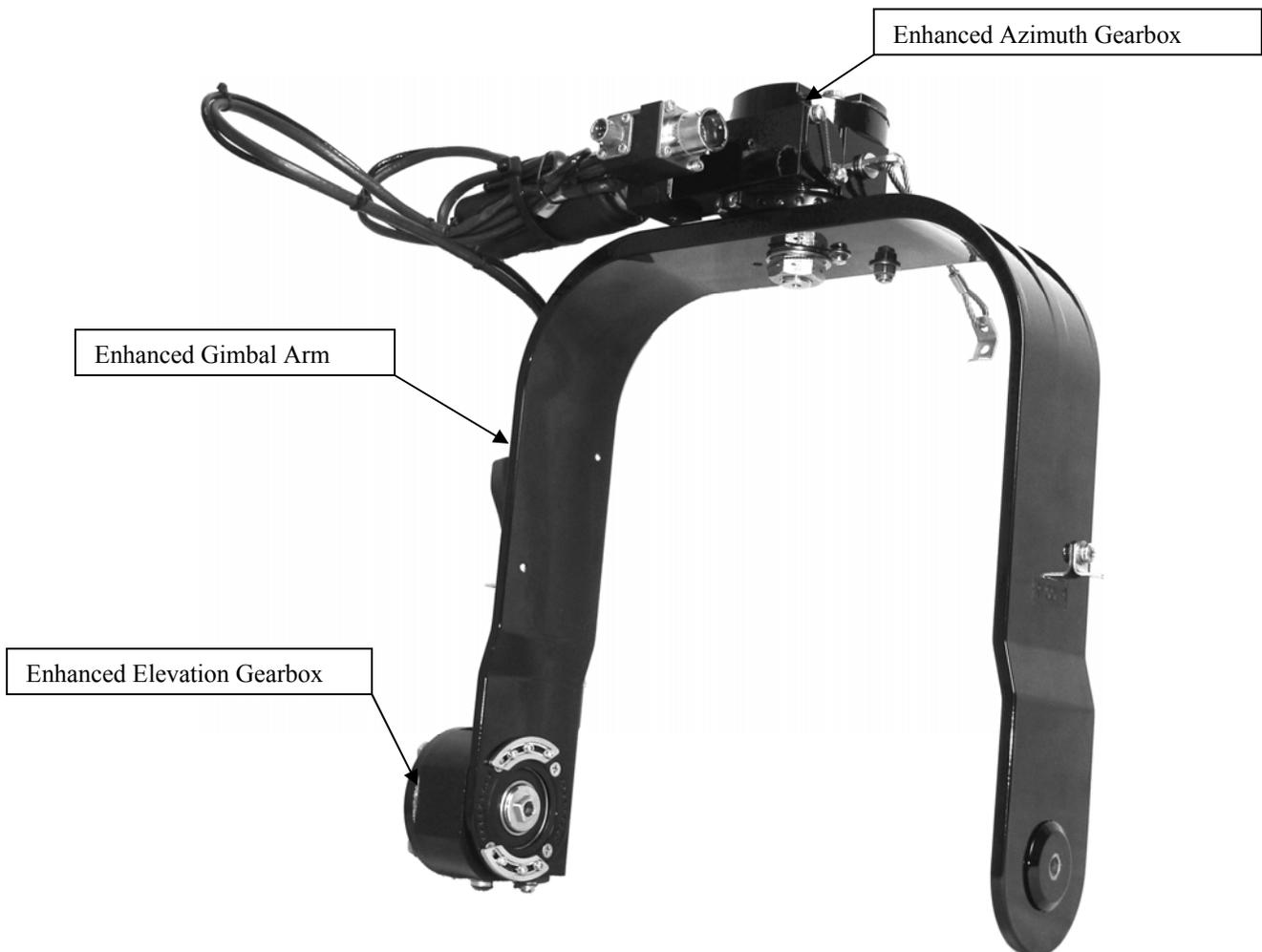


Figure 10 Enhanced Gimbal Assembly (SpectroLink Configuration shown)

Note: Figure may differ from current configuration

4.4 Mechanical Stops

4.4.1 Adjusting the Azimuth Mechanical Stops

The current azimuth stop configuration (figure 11) was introduced in August 2004. It consists of two adjustable stop blocks. Each stop block is attached to the azimuth adapter ring by two shoulder bolts. The stop blocks limit movement of the Gimbal when the stop blocks come into contact with a high strength stationary shoulder bolt that is mounted on the Gimbal Arm. You can detach and reposition the stop blocks to restrict azimuth movement according to your installation and aircraft requirements.

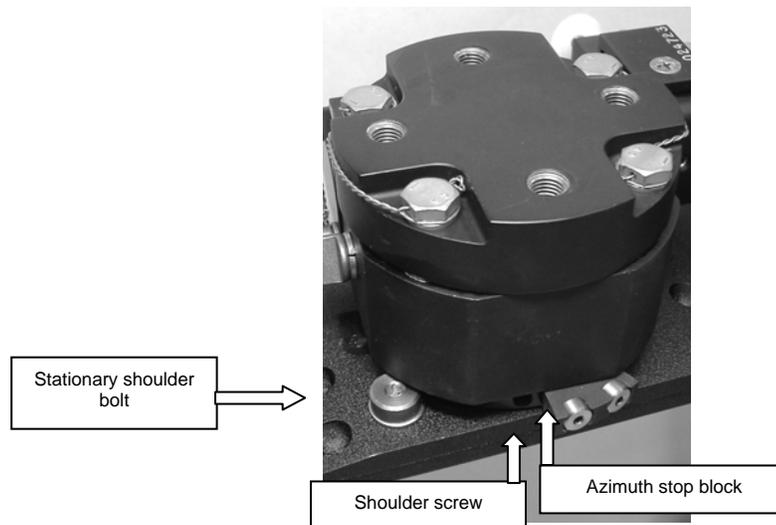


Figure 11 Current Azimuth Stop Configuration (Shown on doubler type Gimbal Arm)

The azimuth travel is limited by two stop blocks with two stop block shoulder bolts on each that are attached to the azimuth ring and the stationary shoulder bolt that is mounted on the Gimbal arm.

To adjust either of the mechanical stops, simply loosen the shoulder screws with a hex tool. Once the screws are loosened and removed, the stop can be positioned as required. When the stop position has been chosen, tighten to the following torque values.

- The torque of each 8-32 stop block shoulder bolt should be 20 inch-pounds (± 2).
- The torque of the $\frac{1}{4}$ "-20 stationary shoulder bolt should be 78 inch-pounds (± 2).

In addition, regularly inspect the condition of the stop block shoulder bolts and the stationary precision shoulder bolt. Replace them if necessary.

Azimuth motion also is limited by the length of the motor wiring. If it is long enough, the motor (and Searchlight) wiring enables the Searchlight to rotate a maximum of 170° to the left and 170° to the right of a center position with respect to the Gimbal (this assumes that the Searchlight/Gimbal are pointed directly forward with relation to the aircraft). The maximum potential movement of the Searchlight, however, will be compromised if the wire becomes twisted around or hampered by the Gimbal components.

4.4.2 Adjusting the Elevation Mechanical Stops

The enhanced Gimbal has two elevation mechanical stops (Figure 12), one to limit the lookup angle and the other to limit lookdown angle of the Searchlight. The stops are adjustable in 2° increments. Adjustments may vary for configuration of the Searchlight and will depend on the installer to determine the settings.

To adjust either of the mechanical stops simply loosen the 6-32 socket head screws with a 7/64 hex tool. Once the screws are loosened and removed, each stop can be positioned as required. When the stop position has been chosen, tighten the screws to 10 inch-pounds with a 7/64 hex tool.

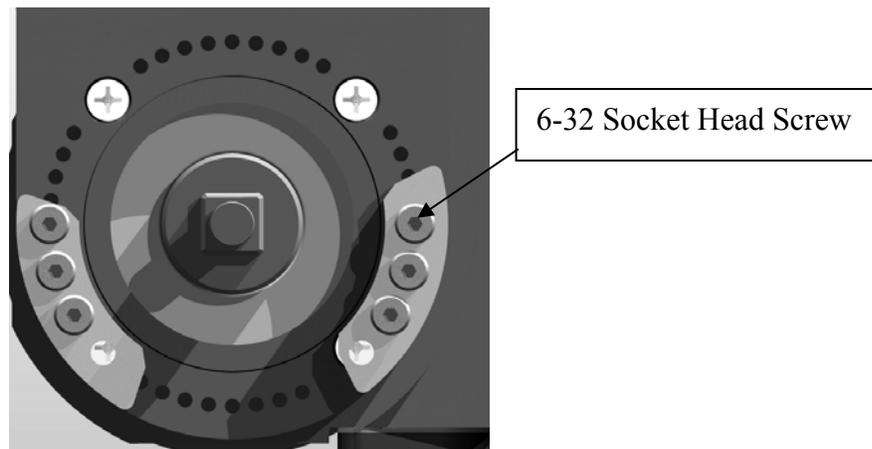


Figure 12 Elevation Mechanical Stops

5.0 SEARCHLIGHT

5.1 Components

The Searchlight assembly also was made available in different configuration. The current configuration (Figure 13) or in the old configuration (Figure 14), both pictured herein. The assembly includes the following components:

- An impact resistant, ¼” thick, Pyrex® glass front window that can withstand mechanical stress, high temperatures, and thermal shock
- A rubber baffle (inside the Searchlight) that keeps light from exiting from the vents at the rear of the Searchlight, which could interfere with the vision of personnel in the aircraft
- A high intensity xenon arc lamp, where light is produced by an electric arc that forms between the tips of two tungsten electrodes called the anode (positive electrode) and cathode (negative electrode):
 - The two tungsten electrodes are permanently sealed in a quartz envelope that contains xenon gas under approximately 30 to 75 pounds of pressure per square inch at normal ambient temperatures of 60° to 90° F. In use, however, the xenon gas reaches 3000° F, and the temperature surrounding the bulb ranges between 800 and 2100° F. Consequently, pressure inside the bulb can rise to 300 psi.
 - Most of the light is produced at a small point, a “hot spot” about 1 mm (0.04”) in diameter, located near the tip of the cathode. Light from this small light source is collected by the reflector and focused into a very tight, high candlepower beam that can be focused down to 4° in diameter. This narrow beam can illuminate targets at up to 1 mile (1.6 km) in distance.
 - The lamp must be handled with great caution. Accidental breakage will result in an explosion of quartz particles because of the pressurized xenon gas within the bulb.
 - During normal, continuous operation, the Searchlight draws the specified 28 volts and 55 to 67 amperes. During the first minute or two of operation, however, it may draw 80 to 85 amps. This decreases to 67 or less as the lamp warms up. Most aircraft electrical systems can support these loads without difficulty. On occasion, non-essential equipment must be de-energized during Searchlight startup, but this equipment can be turned back on after 2 or 3 minutes. The operator can determine if this is necessary by observing the aircraft load meter to make sure that it does not exceed the limits set by the aircraft or equipment manufacturer.
- A lightweight, precision formed, nickel substrate reflector (or collector) that is rhodium plated; it provides a highly reflective coating that collects and focuses light from the lamp to produce an intense beam. The precise thickness of the rhodium plating achieves a reflectivity of 85 to 90%. A coating that is too thin is partially transparent and a poor reflector; a coating that is too thick forms crystals that appear black and can reduce the reflectivity of the coating by more than 50%.
- A focus mechanism and motor to adjust the position of the reflector with respect to the “hot spot” in the bulb:
 - When the reflector is moved to the rear of the Searchlight, the beam increases in diameter.

- The reflector can be moved up to 5.5 mm (0.22”), expanding the diameter of the beam from a minimum of 4° to a maximum of 20°.
- A cooling fan and filter (on the rear of the housing):
- It pushes air over and around the lamp and reflector toward the front window, and it vents through openings in the front of the housing.
- While the light is operating, the air flow from the fan and heat from the light prevent moisture from accumulating inside the Searchlight.
- It is possible for moisture to enter the housing if the light is not operating, but this usually will not interfere with ignition or operation of the lamp.
- Chassis (includes the reflector and all interior components between the reflector and the rear cover inside the Searchlight housing, including electronics such as the starting circuit for the lamp)

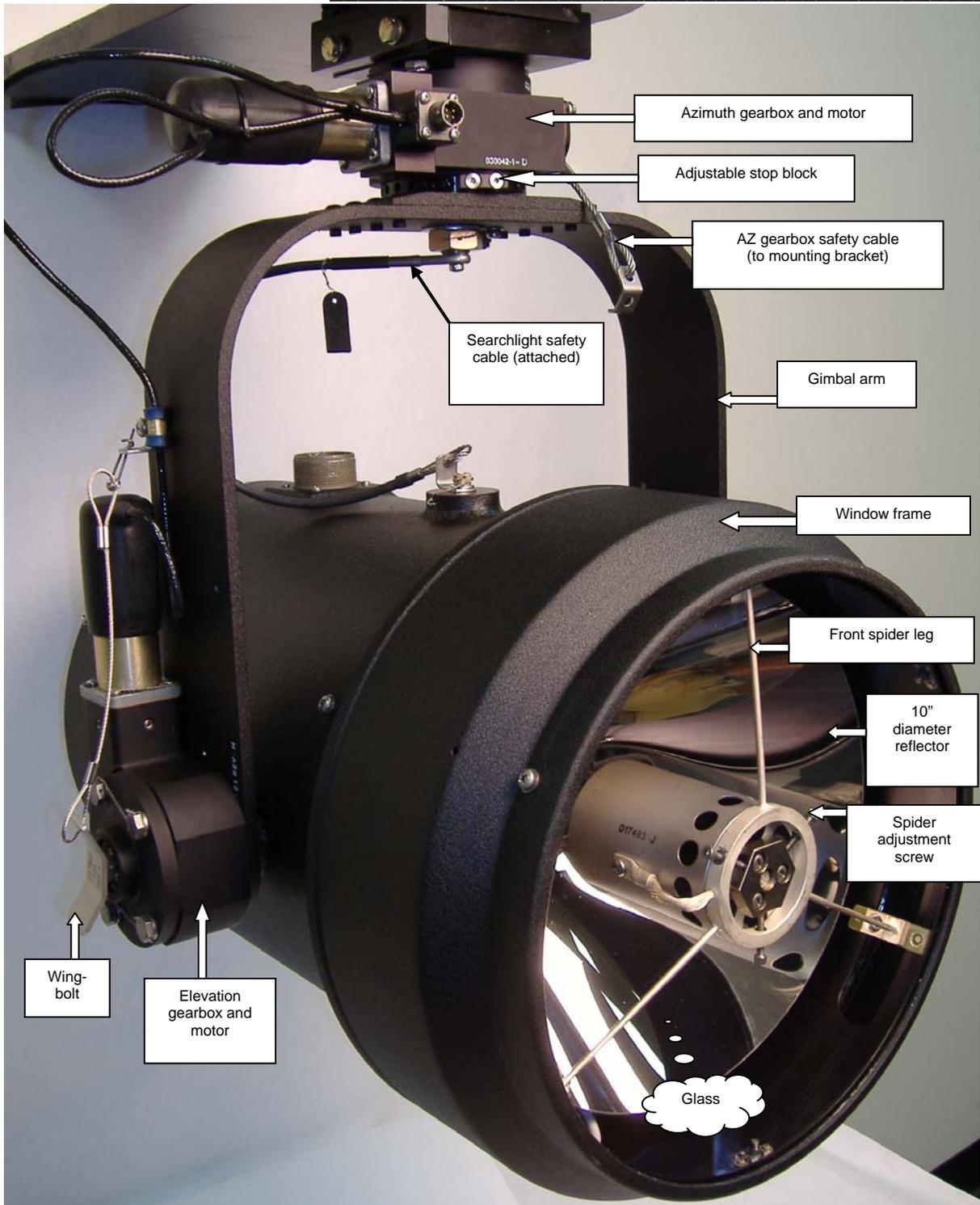


Figure 13 Searchlight Mounted in Gimbal (Current Configuration)

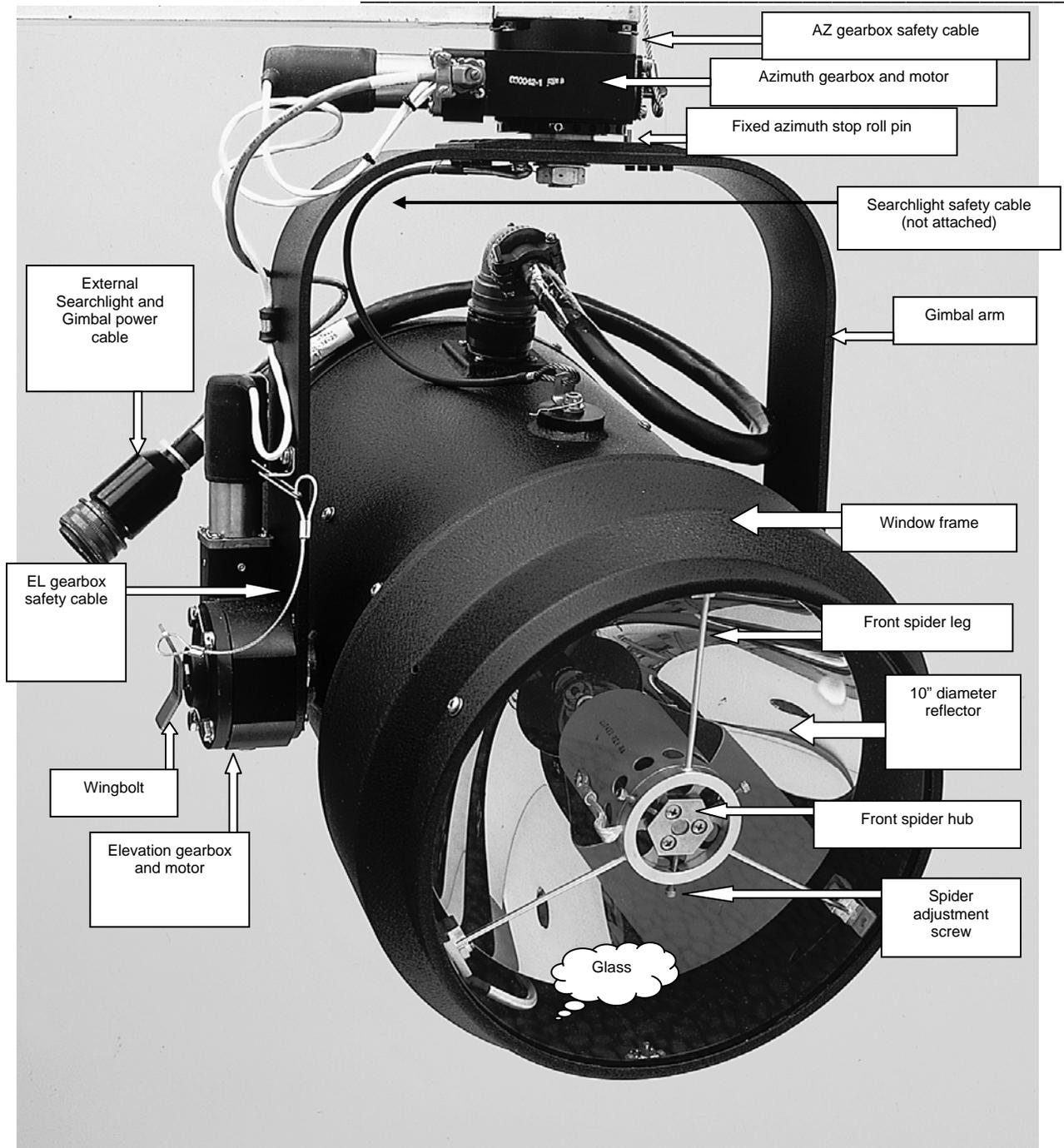


Figure 14 Searchlight Mounted in Gimbal (Old Configuration)

5.2 Enhanced Back Cover Assembly

The enhanced back cover assembly (Figure 15) increases functionality over the basic configuration by adding tracking of lamp operation time with the hour meter (Figure 16), bi-directional focusing, and the extended life brushless cooling blower. Electronics and a sensor track when the operator has ignited the lamp. This component measures lamp ON time in hours and 10ths of an hour and will assist in determining lamp life and operation time. A brushless cooling blower motor increases the mean time before failure to 10,000 hours. This extended cooling blower life allows the operator to run the fan longer and properly cool the lamp. Adding bi-directional focus to the Searchlight allows the operator to focus selectively without having to cycle to reach the desired beam width. The operator can adjust the beam width with the new focus switch on the enhanced Control Box.



Figure 15 Enhanced Back Cover



Figure 16 Hour Meter

5.3 Searchlight Safety Cable

The Searchlight safety cable (Figure 17) is included with the Searchlight Assembly. However, this cable will need to be attached to the Gimbal gearbox shaft. The instructions to attach this safety cable follow (see Figures 17 through 19):

Safety Cable Kit P/N 034296 includes:

- 1- Hex Head Bolt P/N AN3CH4A
 - 1- Lock Washer P/N MS35338-138
 - 1- Flat Washer P/N NAS620C10L
 - 1- Lock Wire
 - 1- Fillister Screw, P/N MS35276-59
 - 1- Flat Washer, No.10 P/N MS15795-808
- Loctite 222 for fillister screw, as required
Anti Seize Lubricant, as required

Instructions:

- Apply anti seize to bolt or screw threads.
- Attach safety cable to Gimbal arm with provided hardware (lock and flat washer(s) and bolt).



Figure 17 Install Safety Cable

- Torque bolt to 27-30 inch-pounds.

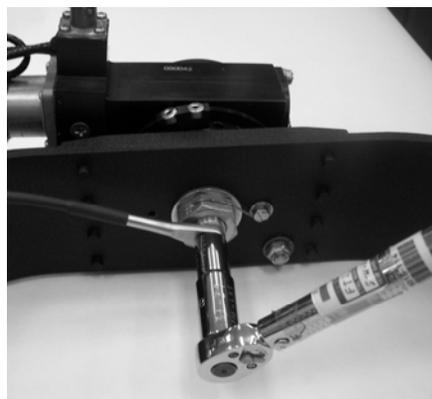


Figure 18 Torque Bolt

- Apply Loctite thread locker (222) to screw threads. Install fillister screw and flat washer to tapped hole on Gimbal arm.
- Lock wire fillister screw and safety cable bolt per NASM 33540 (see Figure 16).

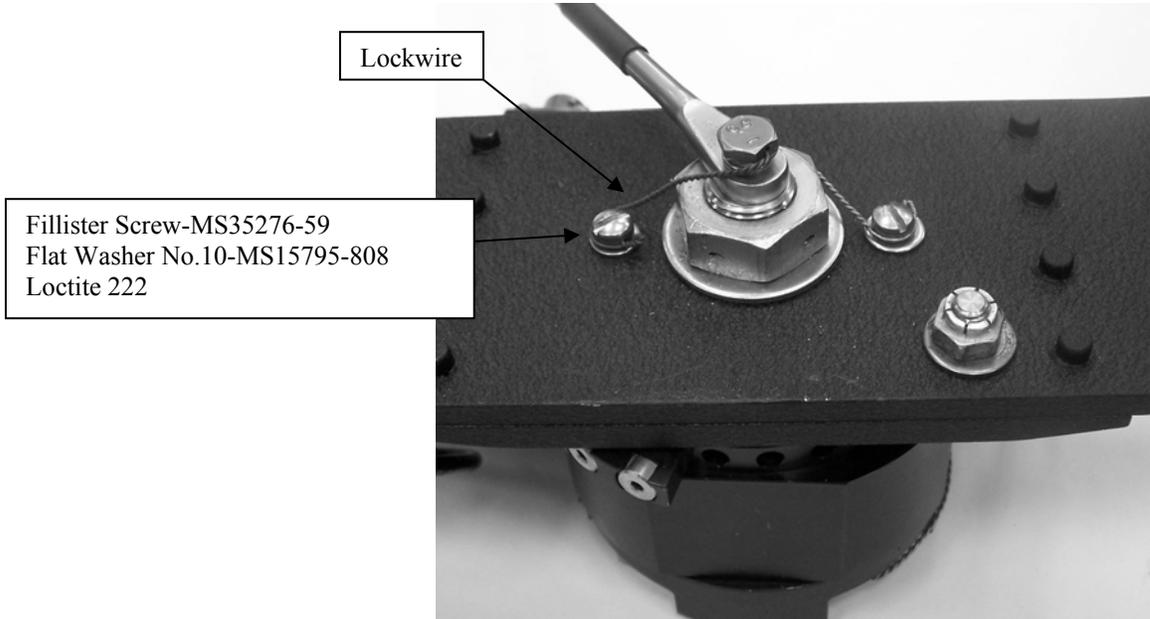


Figure 19 Install Lock Wire

6.0 CONTROL BOX

The Searchlight responds to pointing commands from a Control Box. It can be attached anywhere in the craft or fastened to the operator's clothing. There are three configurations; standard (Figure 20), IFCO (Figure 21) and the enhanced (Figure 22).

The standard Control Box has the following controls:

- A three-position switch that enables the operator to (1) start the xenon arc lamp, turn on the Searchlight system power (but not the lamp), and (3) turn off all power.
- A focus button that changes the beam width from 4° to 20°.
- An eight-way directional switch that controls the azimuth and elevation positions of the Searchlight.



Figure 20 Standard Control Box

6.1 IFCO Control Box

The Searchlight responds to pointing commands from the In Flight Change Over (IFCO) Control Box (Figure 18). It can be attached anywhere in the craft or fastened to the operator's clothing. It has the following controls:

- A three-position switch that enables the operator to (1) start the xenon arc lamp, turn on the Searchlight system power (but not the lamp), and (3) turn off all power.
- A focus button that changes the beam's focus from 4° to 20°.
- An eight-way directional switch that controls the azimuth and elevation positions of the Searchlight.
- An IFCO Open/Close switch that opens and closes the IFCO hood assembly (You must pull up on this switch before you can change its position)
- An IFCO hood position indicator that illuminates when the IFCO hood is closed



Figure 21 Older and Current IFCO Control Boxes

6.2 Enhanced Control Box

The enhanced Control Box (Figure 22) is required for the enhanced Searchlight and allows the operator the following controls:

- A separate Lamp Off switch prevents the operator from shutting down the entire system to extinguish the lamp and allows the fan to run when the system is on.
- The focus switch is bi-directional and can be depressed up and down to adjust beam width. This focus switch replaces the push button switch on the basic Control Box.

Note: The LINK/CAL switch is not installed for this configuration.



Figure 22 Enhanced Control Box

7.0 JUNCTION BOX

The Junction Box links all of the SX-16 Nightsun® components, and it provides the following functions:

- It is the central distribution point for control signals and power.
- It contains some of the lamp starting components and circuitry.

Two types of Junction Box are in use with the SX-16 Nightsun®: the quick connect Junction Box and the hardwired Junction Box (the hardwired Junction Box, however, is no longer in production).

7.1 Quick Connect Junction Box

The quick connect Junction Box (Figure 23) can be added to or removed quickly from the system. It links all of the SX-16 Nightsun® components. Its three connectors include (1) a power connector, (2) a Control Box connector, and (3) a Searchlight/Gimbal connector. Section 3 of this manual describes the connections to the SX-16 Nightsun® components in detail.

The quick connect Junction Box (except where noted) employs 6 AWG connectors instead of hardwired connections. Furthermore, it has no booster assembly attached to the inside of the lid; instead, it uses a DC-to-DC converter. The quick connect Junction Box was made available in three part numbers:

- P/N 032076 (introduced in September 1997); the J2 Searchlight/Gimbal connection has an 8 AWG connector; but the rest are 6 AWG connectors) (only supported for repair)
- P/N 032430 (introduced in October 2001)
- P/N 032430-1 (introduced in October 2006); has a cooling fan mounted inside the lid (see Enhanced Junction Box section)

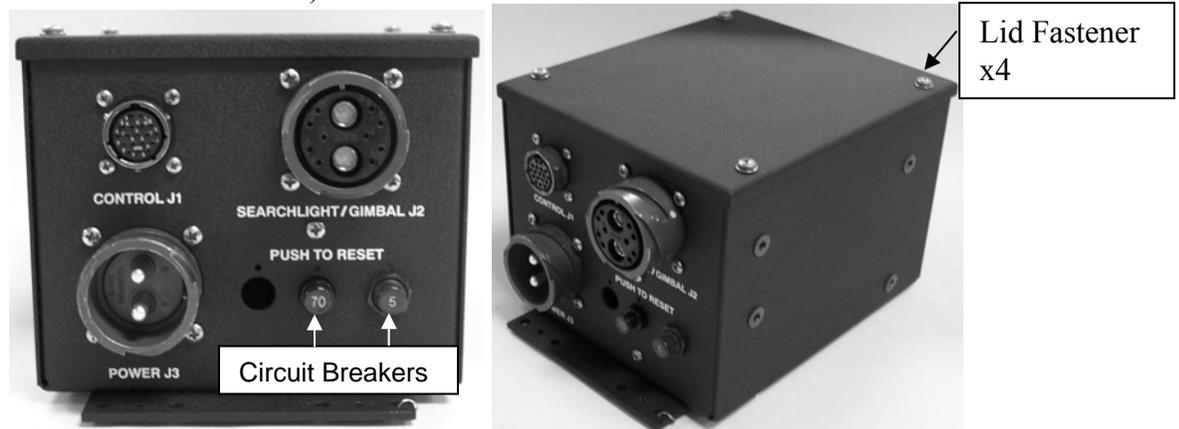


Figure 23 Quick Connect Junction Box

7.2 Hardwired Junction Box

In addition to circuit breakers, the hardwired Junction Box (PN 020706) has three connectors (Figure 24). They include (1) a power connection, (2) a Control Box connector, and (3) a Searchlight/Gimbal connector. Section 3 of this manual describes the connections to the SX-16 Nightsun® components in detail.

- Note that the large grommet in Figure 24 has been replaced with a cord grip on units built after March 1999 with SN 3307 and higher.
- In September 2000, a version of this Junction Box with a power diode attached to the lid became available (not shown).

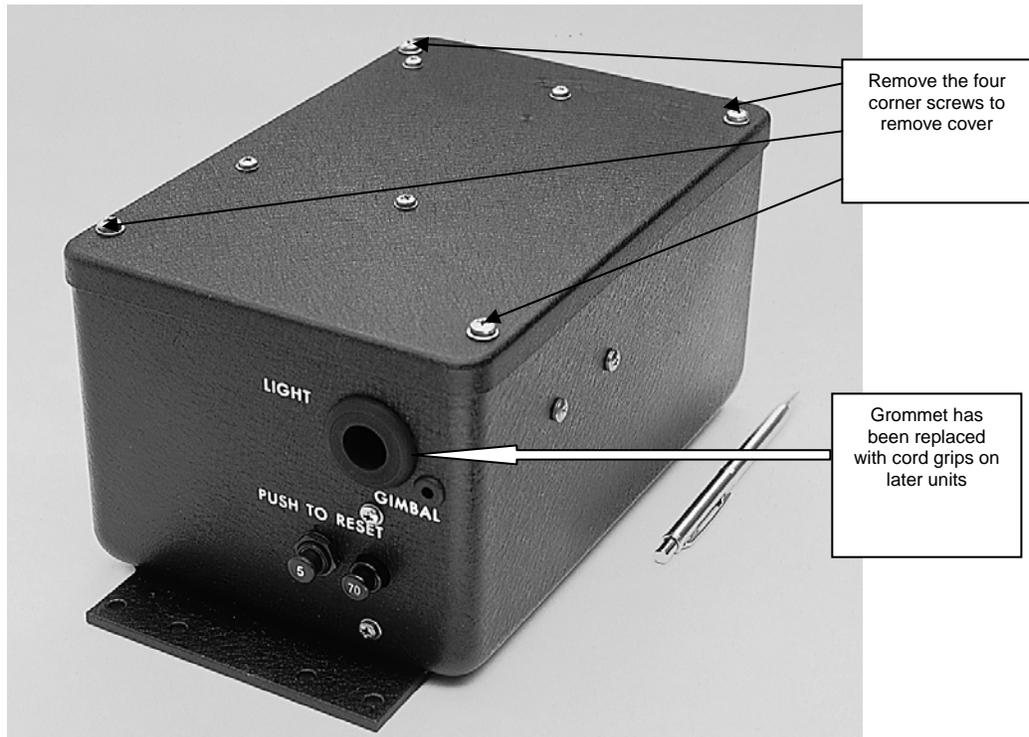


Figure 24 Junction Box (Circuit Breaker Side)

7.3 Enhanced Junction Box

The Enhanced Junction Box (figure 25) adds the cooling fan to the Quick Connect Junction Box. This upgrade adds airflow to increase cooling and prevent temperature triggered circuit breakers from tripping. The addition of the cooling fan is backwards compatible with existing Quick Connect Junction Boxes for upgrade.



Figure 25 Enhanced Junction Box

8.0 IFCO ASSEMBLY

8.1 Introduction

The In Flight Change Over (IFCO) hood (filter) is a remotely controlled, electrically driven filter that can be activated in flight. During operation, the IFCO hood (filter) will filter all light from the Searchlight and permit only the desired light wavelengths to pass through it.

- The operator can switch from white light (using the standard lamp without the IFCO hood) to filtered light in approximately 20 seconds. Figure 26 shows the IFCO hood/filter in the operational (closed) position covering the front of the Searchlight.
- The operator can return the Searchlight from filtered to white light operation in approximately 20 seconds. Figure 27 shows the IFCO filter (hood) in the non-operational open (up) position on top of the Searchlight housing.

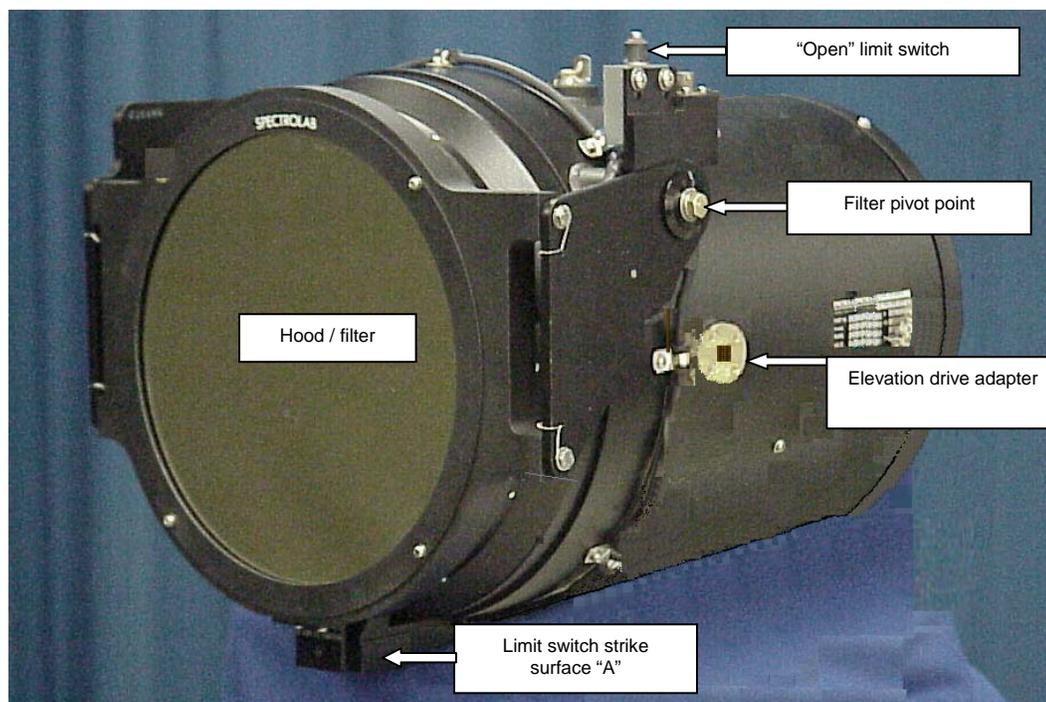


Figure 26 IFCO Equipped Searchlight with Hood in Closed Position

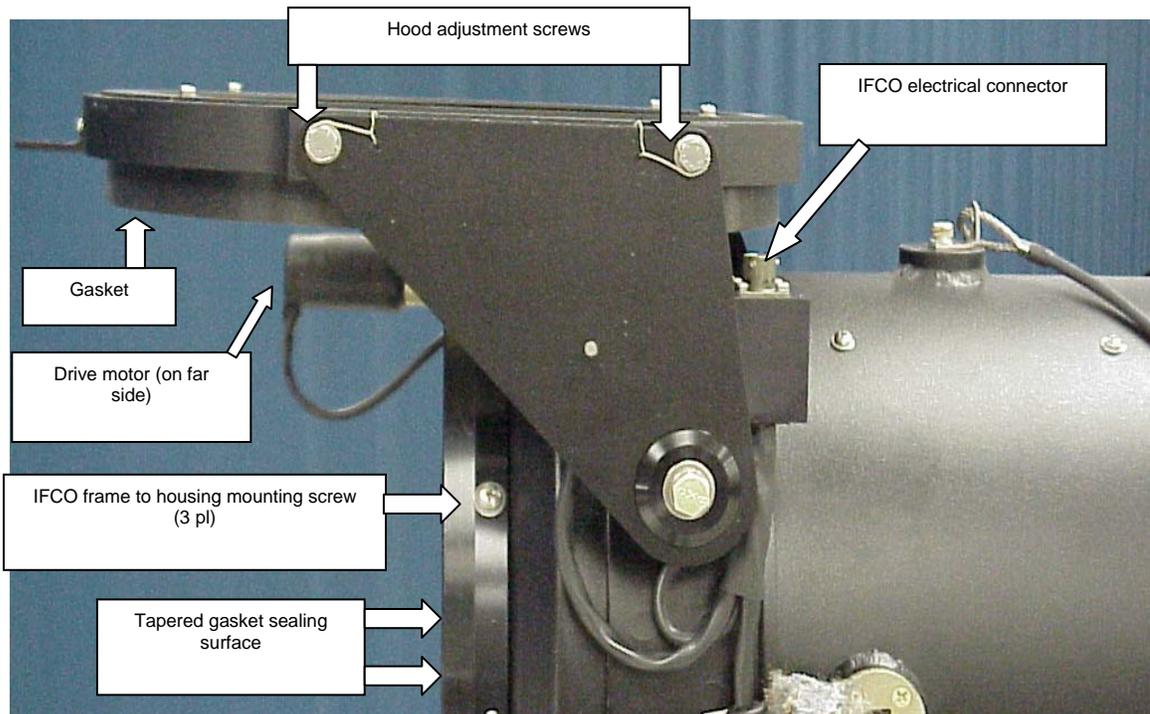


Figure 27 IFCO Hood in Open Position

The IFCO assembly consists of the following components:

- An IFCO filter/hood (with a gasket) mounted in a pivoting housing
- A gear motor assembly that pivots the IFCO filter and housing; it is equipped with a pair of limit switches that control the end of motion motor shutoff:
 - It pivots the filter down into the Searchlight beam during operation of the IFCO hood. This is called the closed (down) position.
 - It pivots the filter up and out of the Searchlight beam to return it to its resting position above the Searchlight housing when the IFCO filter is not in use. This is called the open (up) position.
- A frame with a clear glass window and tapered gasket sealing surface. The frame is attached directly to the front of the Searchlight housing in place of the standard clear glass window, and it always remains in place. When the filter is in the open (up) position, the Searchlight performs exactly the same as a Searchlight that is not equipped with the IFCO option.

The additional weight of the IFCO assembly changes the Searchlight's center of gravity. To compensate for this change, the bosses on the IFCO housing have been located 2 inches forward from the standard position.

NOTICE

The SX-16 Nightsun® IFCO is fully controllable in azimuth and elevation up to IAS of 85 knots. Control can be progressively affected by the slipstream; as a result, the Searchlight can move on its own by slipping the clutch motors.

8.2 Daily (Preflight) Inspection

Every day (or before flight), conduct a mechanical inspection of the Searchlight system to determine if it is flight worthy regardless of whether the Searchlight will be operated or not. If you plan to operate the light in white light or IFCO mode, conduct the full operational test as well.

8.2.1 Mechanical Inspection

8.2.1.1 Wiring

Check the flexible wiring harness from the aircraft skin to the IFCO hood:

- Make sure that the connectors are tight.
- Make sure that the wires are in good condition and are not chafed.
- Make sure that the wire routing and cable ties (wire dress) allow full left-right and up-down Searchlight motion without pulling the wires tight at the extreme limits of motion.

Check the wiring on the IFCO hood:

- Make sure that all wire insulation is sound.
- Make sure that all wires are secured with clamps and wire ties.
- The rubber motor boot should be soft and pliable with no visible cracks or splits.
- The limit switch boots (the Open limit switch and the Close limit switch) should be soft and pliable with no visible cracks or splits, and the limit switches should be screwed firmly in place.

8.2.1.2 Mechanical Components

Check the mechanical components:

- Make sure that the IFCO hood clutch is tight.
- Make sure that all fasteners are tight and lock wires are in place.
- Make sure that the IFCO gasket is soft, pliable, and not torn.

8.2.1.3 IFCO Assembly and Filter Condition

Depending upon operating conditions, the IFCO hood may require daily cleaning. It is exposed to the full slipstream, and it will accumulate dust, insects, and other contaminants. Make sure that the IFCO assembly and hood are as clean as a freshly cleaned windshield.

- The optical coating on IFCO filters is durable, but it can be damaged by abrasive cleaners. Clean the IFCO filter only with liquid non-abrasive glass cleaner.
- If the filter is extremely dirty, use soap and water to pre-clean it; then use the non-abrasive glass cleaner. It is important to remove all soap residues from the filter.
- Dry the filter with paper towels, heated air, or clean compressed air. You also may allow it to air dry after cleaning.

Make sure that the IFCO hood and clear glass are not broken. If necessary, clean the glass in the same way that you clean the hood:

8.2.1.4 IFCO Switch

Make sure that the IFCO Open/Close switch on the Control Box works smoothly and is not broken. You must pull up on the IFCO Open/Close switch before you can shift its position to either the Open or Close positions.

NOTICE

The IFCO control switch is a lift to unlock type. You must lift the switch toggle before switching between open and closed positions. Otherwise, the switch will be damaged.

8.2.2 Operational Test

8.2.2.1 Tests with the Searchlight Off

Place the Start/On/Off switch in the On position to turn on the Searchlight system power (do not turn on the Searchlight).

- Place the IFCO Open/Close switch in the Open position if it is not there already.
- If the IFCO hood (filter) is closed, it will begin to open; if it is already open, nothing will happen.
- As the filter begins to open, the IFCO hood position indicator on the Control Box will turn off.
- The filter hood requires about 20 seconds to completely open. It will stop moving when its edge is parallel to the top edge of the Searchlight housing.
- When the hood is fully open, the motor will stop running.

With the Start/On/Off switch still in the On position (with the Searchlight still turned off) and with the hood in the open position:

- Place the IFCO Open/Close switch in the Close position.
- The hood/filter motor will start running, and the IFCO hood will begin to close. The filter hood requires about 20 seconds to close completely.
- During the last second or so, the motor will slow down as the gasket sealing surfaces make contact with each other.
- When the filter is fully closed, the motor will stop running, and the IFCO hood position indicator on the Control Box will light up.

8.2.2.2 Tests with the Searchlight On

	<p>⚠ WARNING</p> <p>UV Light Hazard.</p> <p>Avoid looking directly at light.</p>	<p>WARNING!</p> <p>Xenon arc Searchlights produce a high intensity light beam during operation.</p> <p>If the beam is directed into the eyes at close range, it can cause permanent eye damage in a fraction of a second. The ultraviolet rich beam can cause severe sunburn to unprotected skin.</p> <p>The beam also can set on fire nearby combustible objects, including clothing and hair.</p> <p>To reduce the risk of serious injury or fire:</p> <ul style="list-style-type: none"> • Never look directly into Searchlight during operation. • Do not expose people to light beam. • Never walk through the light beam. • Alert all nearby people that the Searchlight will be operating. • Always wear protective eyewear when looking at objects illuminated by nearby Searchlight. • Before starting Searchlight, make sure it points down and not toward any objects that may be damaged by light beam. • Keep all flammable objects away from the light beam. <p>During closeup inspection and cleaning activities, the Searchlight must not be turned on. Remove the Control Box or its cable, or disconnect the Searchlight cable so the light cannot be turned on accidentally during the inspection.</p>
	<p>⚠ WARNING</p> <p>Risk of eye injury.</p> <p>Wear eye protection.</p>	
	<p>⚠ WARNING</p> <p>RISK OF SKIN DAMAGE DUE TO UV RADIATION</p> <p>WEAR PROTECTIVE CLOTHING</p>	
	<p>⚠ WARNING</p> <p>BURN AND FIRE HAZARD</p> <p>* HIGH DENSITY LIGHT BEAM FROM SEARCHLIGHT CAN BURN & START FIRES</p>	

Place the Start/On/Off switch in the On position to turn on the Searchlight system power (do not turn on the Searchlight).

- Place the IFCO Open/Close switch in the Open position if it is not there already, and wait for the hood to open.
- Point the Searchlight down or in a safe direction toward a non-flammable, non-reflecting target according to normal operating and safety procedures.
- Place the Start/On/Off switch in the Start position to turn on the Searchlight lamp. Let it run for 1 or 2 minutes to warm up.

Perform the next test in a darkened area or at night. You must remain in a darkened area so that your eyes will be fully adapted to darkness during testing.

- With the Searchlight lamp warmed up and still running (and pointed in a safe direction toward a non-flammable, non-reflecting target):
 - Place the IFCO Open/Close switch in the Close position.
 - The IFCO hood will begin to close. The filter hood requires about 20 seconds to completely close.
 - During the last second or so, the motor will slow down as the sealing surface gaskets make contact with each other.
 - When the filter hood is fully closed, the motor will stop running, and the IFCO filter position indicator on the Control Box will light up.
- Verify that no white light leaks out from the gasket.
- From a position well to the side of the Searchlight, you (or the person whose eyes are adapted to darkness) should look for unfiltered white light leaks. Make sure that there is no unfiltered white light leaking out the front of the light, around the gasket or at the rear.
- It may be necessary to adjust the filter or rear cover trim ring to eliminate all traces of white light. For patrols in urban areas, small amounts of leaking white light may not be important.

9.0 OPERATION

	<p>⚠ WARNING</p> <p>UV Light Hazard.</p> <p>Avoid looking directly at light.</p>	<p>WARNING!</p> <p>Xenon arc Searchlights produce a high intensity light beam during operation.</p> <p>If the beam is directed into the eyes at close range, it can cause permanent eye damage in a fraction of a second.</p> <p>The ultraviolet rich beam can cause severe sunburn to unprotected skin.</p> <p>The beam also can set on fire nearby combustible objects, including clothing and hair.</p> <p>To reduce the risk of serious injury or fire:</p> <ul style="list-style-type: none"> • Never look directly into Searchlight during operation. • Do not expose people to light beam. • Never walk through the light beam. • Alert all nearby people that the Searchlight will be operating. • Always wear protective eyewear when looking at objects illuminated by nearby Searchlight. • Before starting Searchlight, make sure it points down and not toward any objects that may be damaged by light beam. • Keep all flammable objects away from the light beam. • Reference the safety section of this manual for safe distances of objects and people while light is illuminated. <p>During close-up inspection and cleaning activities, the Searchlight must not be turned on. Remove the Control Box or its cable, or disconnect the Searchlight cable so the light cannot be turned on accidentally during the inspection.</p>
	<p>⚠ WARNING</p> <p>Risk of eye injury.</p> <p>Wear eye protection.</p>	
	<p>⚠ WARNING</p> <p>RISK OF SKIN DAMAGE DUE TO UV RADIATION</p> <p>WEAR PROTECTIVE CLOTHING</p>	
	<p>⚠ WARNING</p> <p>BURN AND FIRE HAZARD</p> <p>* HIGH DENSITY LIGHT BEAM FROM SEARCHLIGHT CAN BURN & START FIRES</p>	

9.1 Preflight Inspection Information

Maintenance personnel should conduct a routine check of the SX-16 Nightsun® to keep it ready for use.

- The inspection should be conducted daily if the aircraft is used frequently (more than once each day).
- The inspection should be conducted before each flight if these flights are infrequent (do not take place daily).
- Observe the safety precautions depicted in Section 2.

9.1.1 Visual Inspection

The inspection should include the following tasks:

Inspect components:

- Make sure that the Searchlight housing, mountings, and safety cables are dry, mechanically sound, clean of dust and dirt, and not worn or damaged.
 - Inspect the elevation drive boss welds and nearby housing. Look for signs of cracking in the paint and metal.
 - Inspect the boss weld and nearby housing for the safety cable attachment. Look for signs of cracking in both the paint and metal.
 - Inspect the safety cables that attach the Searchlight to the Gimbal and the azimuth gearbox housing to the aircraft.
 - Verify there is not excessive movement when applying hand-pressure in up, down, left, and right directions. The Gimbal should maintain its position and should not rotate under moderate hand pressure.

Inspect optics:

- Make sure that the front window, reflector, and arc lamp are clean and not obstructed by dirt or moisture.
 - Inspect the window under moderate to strong light such as daylight. Both the inside and outside of the glass should be free of dirt, oil, moisture, water stains, insects, chips and pits, scratches and cracks. If you see significant amounts of dirt on the inside or outside surface of the glass, it must be cleaned.
 - The adhesive bond attaching the glass to the metal frame should have elasticity and be intact all around the circumference of the window; if it is loose, it must be re-bonded.
 - Inspect the reflector for dust or discoloration in a well-lighted area or with a bright portable light such as a flashlight. Look for easily visible dirt or dust, insects or spider webs, leaves and grass, and bits of paper and plastic.
 - Inspect the arc lamp (bulb) for dirt and leaves, insects and spider webs, cracks in the quartz envelope, and loosening of either of the electrodes.

Inspect cables:

- Make sure that the cable connections are tight and cables are not showing any signs of cracking, fraying, or any other type of damage.

Inspect circuit breakers:

- Make sure that the circuit breakers in the Junction Box are pushed in.

Inspect the fan:

- Make sure that the fan intake is clean and not obstructed by dirt or moisture.
- Check the condition of the cooling fan air filter at the back of the Searchlight housing.

9.1.2 Functional Tests

These tests verify critical system functions required for the mission and sustain reliability.

- The functional tests should be conducted daily if the aircraft is used frequently (more than once each day).
- The functional tests should be conducted before each flight if these flights are infrequent (do not take place daily).
- Observe the safety precautions depicted in Section 2.
- It is recommended to power up system prior to flight if system use will be required. Place the Control Box Start/On/Off switch in the on position.

Verify Fan Operation:

- Make sure that the cooling fan functions properly. Listen to the sound of the Searchlight cooling fan during operation; it should sound smooth and even. This test can be performed using battery power on aircraft installations.

Lamp and Focus Function:

- All personnel should remain behind the Searchlight's glass window and never look directly into the Searchlight.
- During lamp operation, wear dark glasses equal to or darker than welder's shade 3 glasses to protect your eyes.
- The test operator's hands must remain out of the beam.
- Searchlight must be mounted on the aircraft or a bench test set; Searchlight cable must be connected to Searchlight.
- Point the Searchlight at a target that is 10 meters (33 feet) away. The target should be dark or medium dark in color, completely non-flammable, and heat resistant at temperatures up to 500° F (260° C) as described in Section 2.1.4.
- Hold the Start/On/Off switch in the Start position until the lamp starts; release the switch when the lamp starts. Allow it to run for a few minutes to stabilize.
- Hold down the focus button to run the Searchlight through its focusing range, from wide (20°) to narrow (4°) and back. Observe the beam on the target as you run through the focus range. It should change focus and be round at all times.
- Turn off lamp, and allow lamp to cool by placing the Control Box in the on position.

Gimbal Movement:

To verify full Gimbal movement, the system should be on.

- Ensure the Gimbal responds to inputs from the Joystick/8-way switch for up, down, left, and right directions.

9.1.3 Searchlights Equipped with an IFCO Assembly

Refer to Section 9 for inspection instructions.

9.2 Standard Control Box Operation

9.2.1 Description

The SX-16 Nightsun® is easy to operate, and it responds to directional commands from the Control Box (Figure 28). It has three controls: (1) a three-position Start/On/Off, (2) a focus button; and (3) an eight-way directional switch that controls the position of the Searchlight.

- **Start/On/Off.** This three position switch controls the power supply to the Searchlight system and lamp. Turning on the xenon gas arc lamp requires a large amount of electrical power. Make sure to bring the engine to full rpm to turn on the lamp if the aircraft is not in flight.
 - The Start (up) position starts the xenon gas arc lamp. To start the lamp, hold the switch in the up position until it starts. When you release the switch, it automatically returns to the On (middle) position.
 - The On (middle) position turns on the entire Searchlight system (including the fan) by supplying power, but it does not illuminate the lamp.
 - The Off (lower) position turns off power to the entire Searchlight system by cutting off power.
- **Focus.** The Focus button controls a mechanism that adjusts the focus of the Searchlight beam from 4° to 20°. It has only one adjustment sequence. If you press this button and hold it down, the beam continuously cycles from a wide focus, to a tight focus, back to a wide focus, and so on.
- **Down/Up/Left/Right.** This eight-way directional switch controls the elevation and azimuth positions of the Searchlight.
 - If you press the switch in the direction that you wish to aim the Searchlight, the Searchlight moves in that direction. It can move up and down, left and right, diagonally to the upper right and lower left, and diagonally to the upper left and lower right.
 - There are no electrical travel limits to the directional control switch. For example, if you point the switch to the extreme Up position and hold it there after the Searchlight has reached the upward limit of travel, the motor will continue to rotate. The torque will be absorbed in a friction clutch. This applies to all switch positions.
 - Release the switch once the Searchlight has been aimed in the direction desired. The switch will return to the central position automatically.
 - The SX-16 Nightsun® has a system of mechanical stops that physically prevent the Searchlight beam from aiming in detrimental directions.



Figure 28 Control Box

9.3 Enhanced Control Box Operation

9.3.1 Description

The SX-16 Nightsun® is easy to operate, and it responds to directional commands from the Control Box (Figure 29). It has following controls: a three-position Start/On/Off switch, a Lamp Off switch, two-position focus switch; and an eight-way directional switch that controls the position of the Searchlight.

- **Start/On/Off.** This three position switch controls the power supply to the Searchlight system and lamp. Turning on the xenon gas arc lamp requires a large amount of electrical power. Make sure to bring the engine to full rpm to turn on the lamp if the aircraft is not in flight.
 - The Start (up) position starts the xenon gas arc lamp. To start the lamp, hold the switch in the up position until it starts. When you release the switch, it automatically returns to the On (middle) position.
 - The On (middle) position turns on the entire Searchlight system (including the fan) by supplying power, but it does not illuminate the lamp.
 - The Off (lower) position turns off power to the entire Searchlight system by cutting off power.
- **Lamp Off.** The Lamp Off switch (Upper) position extinguishes the lamp. The switch will return to the lower position when released.
- **Focus.** The Focus switch controls a mechanism that adjusts the focus of the Searchlight beam from 4° to 20°. If you press this switch in the up or down position, the beam width will adjust.
- **Down/Up/Left/Right.** This eight-way directional switch controls the elevation and azimuth positions of the Searchlight.
 - If you press the switch in the direction that you wish to aim the Searchlight, the Searchlight moves in that direction. It can move up and down, left and right, diagonally to the upper right and lower left, and diagonally to the upper left and lower right.

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- There are no electrical travel limits to the directional control switch. For example, if you point the switch to the extreme Up position and hold it there after the Searchlight has reached the upward limit of travel, the motor will continue to rotate. The torque will be absorbed in a friction clutch. This applies to all switch positions.
- Release the switch once the Searchlight has been aimed in the direction desired. The switch will return to the central position automatically.
- The SX-16 Nightsun® has a system of mechanical stops that physically prevent the Searchlight beam from aiming in detrimental directions.



Figure 29 Enhanced Control Box

9.3.2 Standard Operational Sequence for the Searchlight

To operate the Searchlight, perform the following steps in the order that they are listed.

- Place the Start/On/Off switch in the On (middle) position to turn on the system power.
- Use the Down/Up/Left/Right directional control to point the Searchlight away from the cockpit area before starting the Searchlight in flight. This avoids exposing the pilot to excessive glare. In addition, check the Gimbal movement and the operation of the focus control.
- Place the Start/On/Off switch in the Start (up) position, and hold it in this position until the lamp starts. This usually requires 3 to 5 seconds. Release the switch immediately after the lamp starts.

NOTICE

Holding the switch in the start position after the lamp turns on or during a prolonged series of “strokes” will cause premature failure of some starting circuit components and the xenon gas lamp.

- Adjust the Down/Up/Left/Right directional switch as desired to aim the Searchlight.

- Adjust the Searchlight focus by pressing the Focus button until you obtain the desired beam width.
- Practice using the Searchlight at various altitudes below 3000 feet AGL. The best target identification distance is between 500 and 1,000 feet AGL.
- If the aircraft has minimal ground clearance or if the Searchlight is mounted on the nose of the aircraft, make sure to raise the light to a horizontal position before landing the craft, especially in rough terrain.

NOTICE

Before landing the craft:

- First place the Start/On/Off switch in the Off (lower) position to turn off the xenon gas arc lamp.
- Then place the Start/On/Off switch in the On position to turn the fan on to cool the interior of the Searchlight.
- When the Searchlight has finished cooling, place the Start/On/Off switch in the Off position.

9.4 IFCO Control Box Operation

9.4.1 Description

The SX-16 Nightsun® is easy to operate, and it responds to directional commands from the Control Box (Figure 30). It has three controls: (1) a three-position Start/On/Off, (2) a focus button; and (3) an eight-way directional switch that controls the position of the Searchlight.

- **Start/On/Off.** This three position switch controls the power supply to the Searchlight system and lamp. Turning on the xenon gas arc lamp requires a large amount of electrical power. Make sure to bring the engine to full rpm to turn on the lamp if the aircraft is not in flight.
 - The Start (up) position starts the xenon gas arc lamp. To start the lamp, hold the switch in the up position until it starts. When you release the switch, it automatically returns to the On (middle) position.
 - The On (middle) position turns on the entire Searchlight system (including the fan) by supplying power, but it does not illuminate the lamp.
 - The Off (lower) position turns off power to the entire Searchlight system by cutting off power.
- **Focus.** The Focus button controls a mechanism that adjusts the focus of the Searchlight beam from 4° to 20°. It has only one adjustment sequence. If you press this button and hold it down, the beam continuously cycles from a wide focus, to a tight focus, back to a wide focus, and so on.
- **Down/Up/Left/Right.** This eight-way directional switch controls the elevation and azimuth positions of the Searchlight.
 - If you press the switch in the direction that you wish to aim the Searchlight, the Searchlight moves in that direction. It can move up and down, left and right, diagonally to the upper right and lower left, and diagonally to the upper left and lower right.
 - There are no electrical travel limits to the directional control switch. For example, if you point the switch to the extreme Up position and hold it there after the Searchlight has reached the upward limit of travel, the motor will continue to rotate. The torque will be absorbed in a friction clutch. This applies to all switch positions.

NOTICE

Friction clutch slippage generates heat. Excessive friction clutch slippage may result in clutch or motor failure.

- Release the switch once the Searchlight has been aimed in the direction desired. The switch will return to the central position automatically.
- The SX-16 Nightsun® has a system of mechanical stops that physically prevent the Searchlight beam from aiming in detrimental directions.

- IFCO Open/Close. This switch opens and closes the IFCO hood. When the Searchlight is operating with the hood closed, the beam of radiation emitted by the Searchlight is filtered.

NOTICE

The IFCO control switch is a lift to unlock type. You must lift the switch toggle before switching between open and closed positions. Otherwise, the switch will be damaged.

- If you pull this switch up and then shift it to the Open position, the drive motor raises the frame and filter to the open (hood up) position, which is parallel to the top edge of the Searchlight housing. When it reaches this position, it triggers the Open limit switch, which turns off the motor. It also causes the hood position indicator on the Control Box to go out. The hood requires 20 seconds to move from closed to open.
- If you pull this switch up and then shift it to the Close position, the drive motor lowers the frame and filter to the closed (hood down) position. This blocks all white light from the Searchlight and permits only filtered light to exit. When the filter reaches the closed position, the Close (down) limit switch is triggered. This turns off the motor and causes the hood position indicator on the Control Box to illuminate. The hood requires 20 seconds to move from open to the closed position.

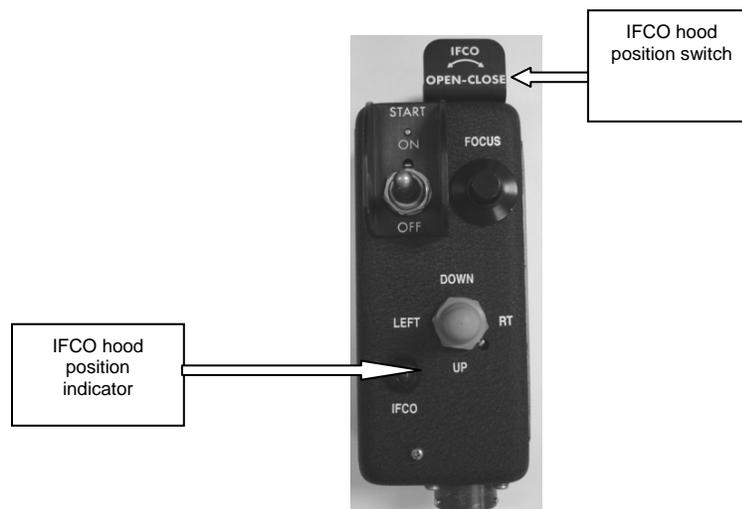


Figure 30 IFCO Control Box

9.4.2 Operational Sequence

To operate the Searchlight, perform the following steps in the order they are listed.

- Place the Start/On/Off switch in the On (middle) position to turn on the system power.
- Use the Down/Up/Left/Right directional control to point the Searchlight away from the cockpit area before starting the Searchlight in flight. This avoids exposing the pilot to excessive glare. In addition, check the Gimbal movement and the operation of the focus control.

Source: Spectrolab, Inc.

- Place the IFCO Open/Close switch in the Close position (you must pull up on the switch before you can change its position). After 20 seconds, the hood will be in place.

NOTICE

The IFCO control switch is a lift to unlock type. You must lift the switch toggle before switching between open and closed positions. Otherwise, the switch will be damaged.

- Place the Start/On/Off switch in the Start (up) position, and hold it in this position until the lamp starts. This usually requires three to 5 seconds. Release the switch immediately after the lamp starts.

NOTICE

Holding the switch in the start position after the lamp turns on or during a prolonged series of “strokes” will cause premature failure of some starting circuit components and the xenon gas lamp.

- Adjust the Down/Up/Left/Right directional switch as desired to aim the Searchlight.
- Adjust the Searchlight focus by pressing the Focus button until you obtain the desired beam width.
- Practice using the Searchlight at various altitudes below 3000 feet AGL. The best target identification distance is between 500 and 1,000 feet AGL.
- If the aircraft has minimal ground clearance or if the Searchlight is mounted on the nose of the aircraft, make sure to raise the light to a horizontal position before landing the craft, especially in rough terrain.

Before landing the craft:

- Place the IFCO Open/Close switch in the Close position (you must pull up on this switch to change its position). After 20 seconds, the hood will be in place.
- First place the Start/On/Off switch in the Off (lower) position to turn off the xenon gas arc lamp.
- Then place the Start/On/Off switch in the On position to turn the fan on to cool the interior of the Searchlight.
- When the Searchlight has finished cooling, place the Start/On/Off switch in the Off position.

9.5 Maximizing and Assessing Lamp Performance

9.5.1 Maximizing Lamp Life

The xenon lamps in the SX-16 Nightsun® are designed to operate for 1,000 hours under ideal conditions. According to the manufacturer, ideal means 1 hour of operation or more after startup. This period of operation is considered ideal because the lamp’s electrodes require 20 continuous minutes of operation to “re-form” (smooth out the erosion and pitting that occur during the startup cycle). If re-forming does not take place, the erosion becomes progressively worse and causes premature bulb failure, which is indicated by failure to start.

A continuous period of operation that exceeds 20 minutes after startup may not be possible for various reasons. Consequently, it is important to schedule a “maintenance” period of lamp on

Source: Spectrolab, Inc.

operation on a regular basis. This lamp on maintenance period of operation should exceed 20 minutes.

9.5.2 Assessing the Need for Lamp Replacement

A decision to replace a lamp should take into consideration all factors, including overall system performance. The following characteristics can help to determine the need to replace a xenon lamp:

- “Hard” lamp starts (the lamp requires more than 3 or 4 seconds to turn on)
- Multiple flashes and “hard” lamp starts before actual startup (the lamp is near the end of its service life)
- Development of a brownish tint on the inside surface of the bulb
- A cracked or otherwise compromised bulb (leads to escape of the xenon gas)

9.5.3 Proper Cooling Procedure

To provide proper cooling for the lamp in your Searchlight, it is imperative to allow the fan to run for 10 minutes after the lamp is extinguished.

The Control Box contains a three-position (Start/On/Off) switch. This three position switch controls the power supply to the Searchlight system and lamp.

- The On (middle) position turns on the entire Searchlight system (including the fan), but it does not illuminate the lamp.
- The Start (momentary up) position ignites the xenon gas arc lamp. When this switch is released, it automatically returns to the On (middle) position.
- The Off (lower) position will extinguish the lamp and turn off power to the entire Searchlight system. Spectrolab recommends that the switch is then moved to the On position for at least 10 minutes. This will turn on the Cooling Blower and allow for the Lamp and other internal Searchlight components to cool completely.

The Enhanced and Spectrolink Control Boxes utilize a momentary Lamp Off button to extinguish the lamp. However, the system must remain on for 10 minutes once the lamp has been extinguished to allow for proper cooling.

Spectrolab Customer Service (800-936-4888) has replacement lamps available for purchase.

10.0 CUSTOMER SERVICE

If you have a question about this manual or need assistance with an SX-16 Nightsun®, please contact Spectrolab Customer Service at 800-936-4888 or by email at customerservice@spectrolab.com.

11.0 SPECIFICATIONS

Illumination Characteristics	
Lamp type/lamp life	1600 watt xenon short-arc / 1,000-hour, 2-year maximum life
Peak beam intensity	30 to 40 million candlepower
Beam width	Adjustable, from 4° (search mode) to 20° (flood mode)
Focus control	Remote control
Electrical Requirements	
Input voltage	28 volts nominal (26.5-29.0 VDC)
Input current	55 to 67 amps nominal (85 amps maximum)
Start time	3 to 5 seconds (typical)
Recycle time	None required
Compatibility	Compatible with most standard aircraft type CD generators; fixed wing applications and accessory power converters available (not from Spectrolab) for operation from other primary power sources from 117-480 VAC, 50-400 Hz; may be operated from batteries or ground power unit
Cooling	Internal cooling fan with filtered air intake
Application Characteristics	
Typical range	3200 ft (1 km)
Useful target ID range	1 mile (1.6 km)
Peak luminance at 1 km	32 lux (2.9 ft-cd)
Beam diameter at 10% of peak luminance	230 ft @3200 ft (70 m @ 1 km)



Beam Diameter and Intensity at Various Distances (Narrow and Wide Focus)				
	4° (Narrow Focus)		20° (Wide Focus)	
Target Distance (ft)	Beam Diameter (ft)	Intensity on Target (foot candles)	Beam Diameter (ft)	Intensity on Target (foot candles)
50	3.5	1920.0	17.5	80.0
100	7.0	480.0	35.0	20.0
200	14.0	120.0	70.0	5.0
300	21.0	53.0	105.0	2.2
400	28.0	30.0	140.0	1.25
500	35.0	19.2	175.0	0.8
600	42.0	13.3	210.0	0.55
700	49.0	9.8	245.0	0.4
800	56.0	7.5	280.0	0.31
900	63.0	5.9	315.0	0.24
1000	70.0	4.8	350.0	0.2

Physical Characteristics	
Searchlight / Gimbal	
Maximum / minimum height	24.4" (61.9 cm) at max. lookdown / 19.71" (50 cm) in horizontal position
Searchlight dimensions / weight	18" (46 cm) long; 11" (28 cm) outside diameter / 25 lb (11.4 kg)
Gimbal assembly dimensions / weight	18" (46 cm) long; 15" wide / 9 lb (4.1 kg) or 15 lb (6.8 kg) for high speed
Azimuth rotation	340° (dependent upon service loop of External Cable)
Searchlight / Gimbal performance	The Searchlight / Gimbal is fully controllable in azimuth and elevation up to 125 knots. Above 125 knots, control is progressively affected by the slipstream; this can cause the Searchlight to move on its own by slipping the clutches in the gearboxes.
Elevation stops (fixed)	Mechanical limits: (1) on white light installations, +2° maximum lookup to -67° maximum lookdown (computed from a horizontal platform; full movement capability cannot be utilized on all helicopters); (2) on IFCO installations, 0° maximum lookup to -50° maximum lookdown
Slew rate	9°/sec (standard); 18°/sec (high speed option)
Azimuth stops	Adjustable in azimuth
Junction Box	
Dimensions	6.25" W x 10.5" L x 5.5" H (15.9 x 26.7 x 14 cm) for P/N 020706 6.18" W x 7.88" L x 5.06" H (15.7 x 20 x 12.8 cm) for P/N 032076, 032430 and 032430-1
Weight	8.6 lbs (3.9 kg) for 020706 6.1 lbs (2.8 kg) for 032076, 032430 and 032430-1
Control Box	
Type	Two-axis remote electrical control
Dimensions	2.25" W x 5" L x 1.75" H (5.7 x 12.7 x 4.4 cm)
Weight	0.62 lb (281 grams)
Total System	
Weight	55-64 lbs (25-30 kg) depending upon hardware and cable lengths

12.0 GLOSSARY AND ACRONYMS

This glossary lists terms, acronyms, and symbols that appear in the manual.

μf	microfarad, a unit of capacitance equal to one millionth of a farad
AGL	above ground level
anode	positive (+) electrode at the rear end of the xenon gas lamp (it is larger than the cathode)
APU	auxiliary power unit
azimuth	horizontal (compass) directions with respect to the Gimbal's mounting plane
backlash	a sudden violent movement or reaction against pressure (the original pressure can be either forward or backward or side to side, and the backlash movement is in the direction opposite to the original movement)
bulb (lamp)	Xenon gas arc lamp located in the Searchlight
cathode	negative (-) electrode at the front end of the xenon gas lamp (it is smaller than the anode)
chassis	includes the structural and electronic components inside of the rear portion of Searchlight housing (including the starting circuits, fan mechanisms, optics (the reflector), and focus mechanism
circuit breaker	switch that interrupts electrical current under abnormal conditions
collector	reflector
CB	circuit breaker
Control Box	Hand held control unit consisting of switches and status indicators; it enables the operator to control the SX-16 Nightsun®
duty cycle	the fraction of time that a system is actually employed in performing its function; the ratio of "on" time to "off" time during the operation of a component
DVOM	digital volt-ohm meter
electrode	electrical conductors that create the intense light in the xenon arc lamp (see anode and cathode)
elevation	vertical directions (up and down) with respect to the Gimbal's mounting plane
EMI	electromagnetic interference
ESD	electrostatic sensitive device (a component that requires special handling because it is sensitive to electrostatic discharge)
FMS	Flight Manual Supplement
focus	control that narrows or widens the light beam
galling	the joining or sticking together of two metal parts as a result of friction between them
Gimbal	also referred to as a "pan-tilt" mount, a mechanical structure that supports the

Source: Spectrolab, Inc.

	Searchlight head and enables pointing of the light; it includes mechanical supports, motors, gears, and electronic equipment; serves as an interface between the Searchlight head and Junction Box
IAS	indicated air speed
IFCO	In Flight Change Over (an option)
IPA	isopropyl alcohol (electronic grade)
Junction Box	also referred to as a “J-Box,” serves as a connection point between cables connecting other system components
kn	knot
lamp (bulb)	xenon gas arc lamp located in the Searchlight
lamp adapters	attached to both ends of the xenon gas lamp, these removable fixtures hold the lamp in position
lead dress	cable tie
mechanical stop	located inside the Gimbal mechanism, a mechanical stop limits the range of movement (azimuth and elevation) to prevent the Searchlight beam from being aimed in detrimental directions; mechanical stops include adjustment stop blocks and fixed stop blocks (for elevation) and hard stops (for azimuth)
MEK	methyl ethyl ketone; a solvent used to remove silicone adhesive
MTBF	mean time between failure
OD	outside diameter
PC	printed circuit
PCB	printed circuit board
PN	part number
pot, potting, potted	to encapsulate or embed (to pot); encapsulating or embedding (potting); encapsulated or embedded (potted); for example, wires are embedded in RTV in many of the connections
psi	pounds per square inch
reflector	collector
RFI	radio frequency interference
rpm	revolutions per minute
RTV	Room temperature vulcanizing; the curing of rubbery compounds at room temperature caused by the linking of polymer molecules
Searchlight	consists of a housing and front glass window (or lens) containing a high intensity xenon arc lamp, optical system, cooling fan, and electronics
slave system	directional controller or other device that controls the Searchlight to enable synchronized positioning between this device and the Searchlight, enabling them to track and slave together
slew rate	the speed of the Gimbal movement
SN	serial number

spider	there are two spiders: (1) a front spider and (2) a rear spider
strobe	the lamp flashes
Swaged end fitting	an end fitting onto which a metal fitting is cold-pressed to the cable to attach it
SX-16 Nightsun® Searchlight System	system consisting of the Searchlight, Gimbal, Junction Box, Control Box, and associated cables
SX-16 Nightsun®	shortened form of SX-16 Nightsun® Searchlight System
VAC	volts alternating current
VDC	volts direct current
Worm	the driving gear in the gearbox
worm gear	the gear shaft that is driven by the worm in the gearbox

13.0 INSPECTION CARD

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Nightsun® SX-16 and
SX-5 Starburst Searchlight Systems

Preflight Checklist

Visual Inspections

Verify:

- ✓ Searchlight mounting tight and secured
- ✓ Safety Lanyards are attached
- ✓ Safety Cables
 - Searchlight to Gimbal
 - Gimbal Arm to Aircraft
- ✓ Searchlight/Gimbal is without excessive side to side or up and down movement
- ✓ Cable connections are without abrasion or damage
- ✓ Fasteners are without corrosion or damage
- ✓ Front window is clean and without damage

Functional Tests

Searchlight Operations

Verify:

- ✓ On, Off and Lamp Start
- ✓ 8-way Control
- ✓ Focus
- ✓ Fan

Optional equipment

- ✓ IFCO filter

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Nightsun® SX-16 and
SX-5 Starburst Searchlight Systems

Recommended Daily Inspection

This routine should be performed by maintenance personnel in addition to the Preflight Checks on the opposite side of this card. Refer to the maintenance manual details.

Visual Inspections

- Inspect the Searchlight to aircraft fasteners for corrosion and integrity.
- Inspect all safety locking devices such as lock wire, safety cables and locking inserts.
- Inspect Azimuth stop pins and elevation stop plate for signs of damage, corrosion and integrity.
- Inspect the Reflector for signs of corrosion or debris
- Inspect base of drive bosses on Searchlight housing for cracking welds.

Functional Tests

- On, Off, Lamp Start - Allow lamp to run for one to two minutes.
- Observe Cooling Blower for intermittent operation or abnormal sounds.
- Observe that the lamp is properly focused.
- Verify azimuth and elevation clutch breakaway torque.